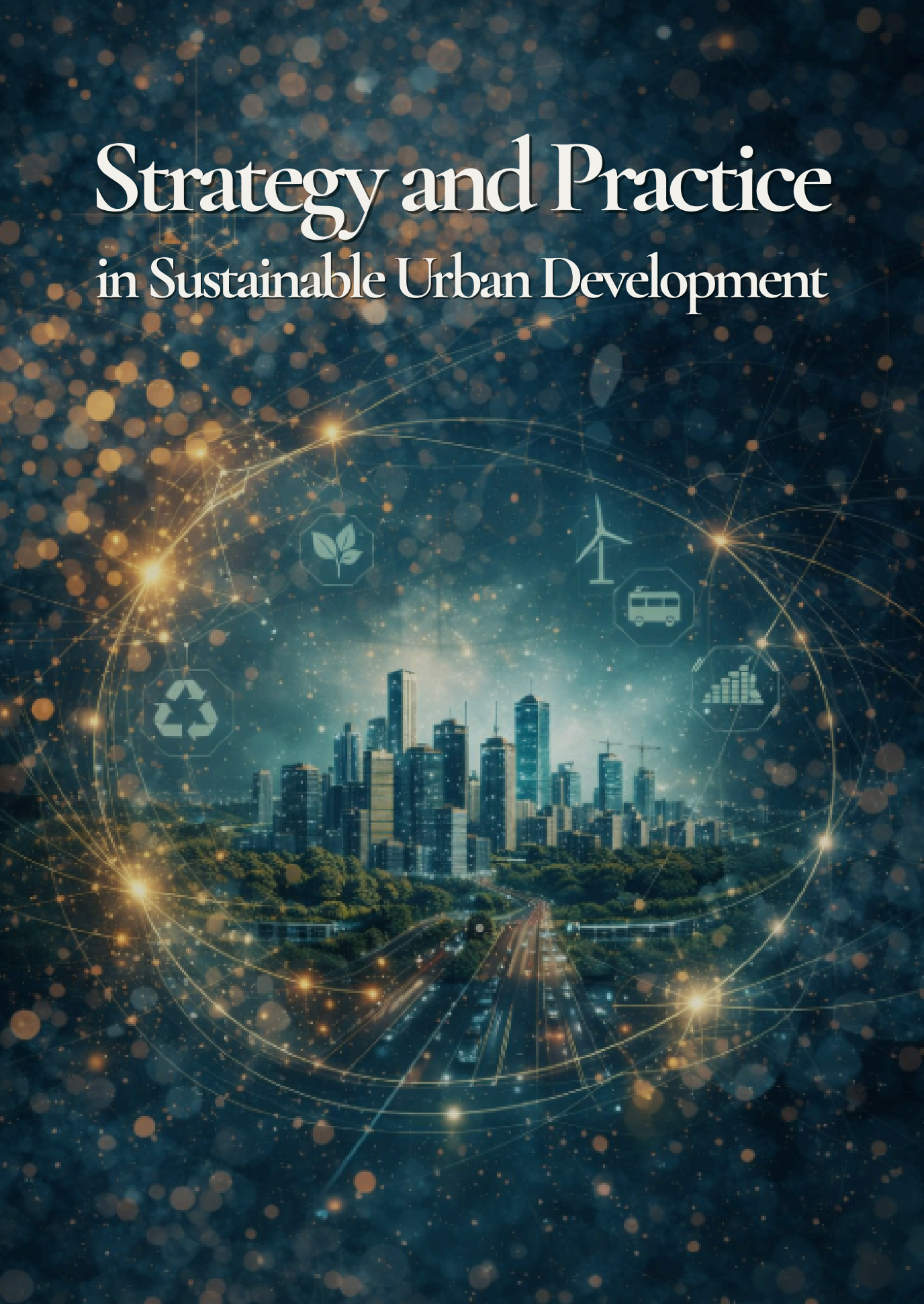
Strategy and Practice in Sustainable Urban Development



Strategy and Practice
In Sustainable Urban Development

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2026

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Co-funded by
the European Union

Edited by: Szilvia BEKE, Edit HAJNAL

ISBN - 978-615-7070-19-6 (print)

ISBN - 978-615-7070-20-2 (online)

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Published by: Municipality of Gyula, Gál Ferenc University

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Strategy and Practice in Sustainable Urban Development

Róbert Molnár

COMMUNICATING ON CLIMATE CHANGE IN SERBIA: A CASE STUDY OF THE CITY OF ZRENJANIN

Abstract

Global warming was first observed worldwide over a century ago. It has had a significant impact on the global climate, with all its negative consequences. There is evidence that the climate change we are witnessing today is caused by anthropogenic factors, i.e. human economic and other activities. This leads us to the logical conclusion that if human activity has been identified as the primary cause of the triggering and acceleration of climate change, then it is up to humans to find a way out of it.

It seemed much easier to deal with climate challenges. But if we take into account the various factors that are making our climate worse day by day – such as oil companies' profit margins and people's general well-being – it becomes clear that future actions must be comprehensive and have long-lasting positive effects.

Communication plays a very important role in addressing climate change. The results of the research clearly show that Zrenjanin, as the central and most populous city in the Middle Banat district of Serbia, is only just beginning to communicate the challenges posed by climate change.

Keywords: *climate change, communication, media, raising awareness*

Introduction

During the First Industrial Revolution, technologies based on human and animal labour were transformed into various machines and associated processes. Most of these technologies were based on the combustion of fossil fuels (Mohajan, 2019). With the Second Industrial Revolution, however, when the internal combustion engine was invented, humanity finally paved the way for global climate change, which was further accelerated by other human activities such as deforestation, landfilling, and certain industrial operations (Weart, 2024).

Since we are all users/consumers of the benefits of technologies harmful to the environment, we are consequently all more or less responsible for the greenhouse effect and, by extension, for climate change. This statement can serve as a starting point for communication on climate change. However, in addition to environmental considerations, other factors must be taken into account when communicating about climate change, such as profit opportunities arising from environmental neglect and prohibitively expensive new environmentally friendly technologies.

We must be very careful when communicating with individuals about how someone should change their lifestyle to save our planet. It has been found that the invention and implementation of environmentally friendly, so-called 'green' technologies may offer a solution to mitigating climate risks (Molnar, Kanev & Cekić, 2025). However, without changing individuals' everyday habits regarding environmentally friendly behaviour, all efforts to save our planet may fail.

A wide range of social actors must be involved in communication regarding climate change, even at the local level. Some argue that this must begin from birth, or at least from nursery age, when everyone must learn environmentally friendly behaviour through appropriate communication (Japundža & Mirkov, 2025). This type of learning, or even education, must continue throughout the entire formal and informal education system, in the hope that every lesson or example learned will one day be put into practice when the individual enters the labour market or starts their own business. Governments, businesses and civil society organisations must therefore work closely together, in the hope of finding the most appropriate means of communication amongst themselves, and ultimately with households and individuals.

Local authorities have a particular responsibility when it comes to communicating about climate change. They must use all available resources to keep climate change in the public eye. Every message sent to the public must take into account the public's level of knowledge, attempting to simplify scientific language, whilst relying on educational institutions to do so (Centre for Research on Environmental Decisions, 2009). Meanwhile, the media also plays a huge role. It must describe the severity of environmental problems and the associated solutions in simple, direct language. A wide range of media can be considered suitable visual communication channels.

Methods

In this study, a questionnaire-based approach was used as the primary research method. For this purpose, a Google Form consisting of 16 questions was prepared. It was structured to elicit responses distinguishing between environmental and climate change issues at both the local and national levels.

The second research method employed was desk research. Using this method, we divided the research literature into two groups: 1. Primary sources, which address the background, importance, and application of communication; and 2–secondary sources, which explore the roots of climate change and explain its associated consequences.

Results

This research focused on the municipality (town) of Nagybecskerek, which had a population of 105,722 in 2024. The municipality is home to four utility providers and one public institution, all of which are, to varying degrees, connected to environmental and climate change-related issues. In addition to these, there are two higher education institutions (a technical faculty and a technical college) and seven secondary schools. In terms of media, there are two television stations, a weekly newspaper, and numerous online outlets. The civil sector is quite well developed in terms of numbers, but in practice, it is not very active.

As part of the research, the majority of the listed institutions/organisations responded to the questionnaire entitled “Climate Change and Communication Channels in the Municipality of Nagybecskerek”. Generally speaking, the results indicate that climate change issues are not sufficiently topical in the municipality.

Of the 16 questions asked, only the most significant results will be detailed below.

The third question aimed to map the communication channels available in the town. The results suggest that modern communication is fairly widespread, whilst traditional communication channels, such as the print media or public appearances/discussions, still play a significant role in practice. Details can be found in Table 1.

Table 1. Channels of communication with the environment (multiple answers were possible).

	Percentages
Via the print media	61.1%
Via electronic media	94.4%
Via the internet	83.3%
Printed materials (leaflets, posters, newsletters, etc.)	50.0%
In person (public appearances, conversations, etc.)	61.1%
Other	11.1

The aim of questions 4 and 6 was to assess the activities of municipal institutions and organisations related to environmental protection and climate change. The results primarily suggest that climate change became more significant than environmental protection in the previous year. It should be added that, over the past two or more years, the topic of climate change has not featured prominently on the agenda of these institutions and organisations. Viewed from another angle, the survey results make it clear that environmental protection and climate change are not particularly significant issues for municipal institutions and organisations. More specifically, over the past 1–3 years, environmental protection has been on the agenda of only half of them, whilst climate change has been on the agenda of far fewer than half. Details can be found in Table 2.

Table 2. The organisation has carried out or is currently carrying out activities/providing information relating to environmental protection/climate change *issues (multiple answers were possible).*

	Percentages (environmental protection)	Percentages (climate change)
In the past year	44.4%	50.0%
In the last 1–3 years	50.0%	27.8%
In the last 3–5 years	27.8%	11.1%
More than 5 years ago	22.2%	22.2

The aim of questions 5 and 7 was to assess the media coverage of the activities of municipal institutions/organisations. We can reasonably assume that respondents considered only local media, given that their institutions/organisations conduct only locally significant activities. The results primarily suggest that environmental protection and climate change receive very limited coverage in the media. The environmental protection and climate change activities of institutions/organisations are generally covered in the media once or less frequently, 3–5 times. When a particular institution or organisation organises a significant event or major initiative, it is covered by several media outlets. However, this occurs very rarely; indeed, it was observed in only one response. Details can be found in Table 3.

Table 3. How much media coverage did the various activities receive?

	Percentages (environmental protection)	Percentages (climate change)
Once	38.9%	61.1%
3–5 times	44.4%	33.3%
6–10 times	11.1%	0.0%
More than 10 times	5.6%	5.6%

The aim of questions 12 and 14 was to assess the coverage of climate change issues in the media at both the national and city levels. In this case, too, there is a good reason to assume that respondents were less objective and assessed reality from the narrow perspective of their institution or organisation. It should also be noted that the national-level estimate is heavily influenced by the respondent's general cultural background and level of awareness. The results primarily suggest that climate change is under-represented in the media, particularly at the national level. Generally speaking, the overwhelming majority of respondents consider climate change to be underrepresented in the media, both at the national level and, even more so, at the city level. Furthermore, one cannot ignore the number of respondents who believe that climate change issues are not covered at all in the Serbian media, and even less so in the media in Nagybecskerek. Details can be found in Table 4.

Table 4. Opinions on the coverage of climate change issues in the Serbian/Nagybecskerek media landscape.

	Percentages (Serbia)	**Percentages (Nagybecskerek)**
Does not exist	11.1%	22.2%
Very modest	27.8%	27.8%
Exists, but not enough	55.6%	38.9%
High	5.6%	11.1%
Too large	0.0%	0.0%

The aim of question 15 was to assess the reasons behind the level of media coverage of climate change issues, particularly at the local level. In this case, particular attention had to be paid to the option of multiple answers, as there may have been more than one reason for the current situation. The overwhelming majority of respondents cited the (low) level of public awareness of climate change issues as the main reason. This result is

acceptable in itself, but it is more than likely linked to the other options offered. For example, if the local government's stance on this issue were clearer and more decisive, one might expect awareness of the problem to increase at both the individual and organisational/institutional levels. In this way, the local government's behaviour would also influence the media, leading them to devote more coverage to climate change issues. It is reasonable to expect that sponsors and donors would then be more willing to support such causes. A rather interesting finding is that respondents working in the relevant institutions/organisations do not fully recognise their own role in this regard. Details can be found in Table 5.

Table 5. Reasons for influencing the extent of media coverage of climate change issues in Nagybecskerek (multiple answers possible).

	Percentages
The local government's stance on this issue	38.9%
Our organisation's stance on this issue	16.7
Lack of appeal of the topic for the media	38.9%
Lack of appeal of the topic to the wider public	27.8
Lack of appeal of the topic to sponsors/donors	11.1%
Level of awareness of the issue	72.2%
Other	11.1

Summary

The town of Nagybecskerek has not yet placed climate change at the centre of its agenda. This applies not only to local authorities and public utilities, but also to the academic community and the media (newspapers, TV, radio, internet). There are, however, isolated instances (projects, media articles, scientific conferences, and related articles) concerning communication on climate change, but without any visible changes at the local level.

The communication process regarding climate change in the town of Nagybecskerek and in Serbia as a whole needs a wider platform in public

discourse to raise awareness among different social groups and citizens, a problem that has proven to be one of the main challenges in climate change communication.

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Enikő Sógor

SUSTAINABLE CITIES AND SUSTAINABLE COMMUNITIES: A SYSTEM-LEVEL MODEL OF MIERCUREA CIUC'S MENTAL HEALTH, PREVENTION AND SPORTS PROGRAMMES

Abstract

Contemporary approaches to sustainable urban development increasingly recognise that environmental and infrastructural interventions alone are insufficient to ensure the long-term viability of cities. Social sustainability, particularly the mental and physical health of communities, is increasingly regarded as a fundamental prerequisite for building resilient urban environments. This paper presents the mental health, prevention, and sports programmes of the City of Miercurea Ciuc as an integrated, system-level municipal model aimed at strengthening sustainable communities by promoting well-being. The model presented operates across four interrelated levels of intervention: support for school leaders and teachers, development of children's coping capacities, strengthening of parental roles, and the establishment of institutional mechanisms for prevention and protection. In addition, city-wide mental health and sports-based prevention programmes further reinforce social cohesion and health-conscious lifestyles. The case study demonstrates that locally implemented, complex, and prevention-oriented interventions make a meaningful contribution to reducing the burden on educational environments, strengthening community trust, and laying the foundations for long-term urban sustainability.

Keywords: *mental health, prevention, community well-being, sustainable urban governance*

Introduction

For a long time, the concept of sustainable urban development in the literature and in public policy thinking focused primarily on ecological sustainability, energy efficiency and the development of the built environment. In recent decades, however, the approach has broadened significantly: the social dimension of sustainability has become increasingly prominent,

encompassing community cohesion, individual and community well-being, and mental and physical health (Dempsey et al., 2011). Both the international literature and health policy approaches highlight that urban living conditions directly affect population mental health; therefore, integrating health considerations is essential to the development of sustainable and resilient cities (World Health Organisation, 2016; Tonne et al., 2021).

In the period following the COVID-19 pandemic, the prevalence of anxiety and depressive symptoms has increased globally, particularly among children, young people and those working in education. According to data from the World Health Organisation, between 2019 and 2021, the prevalence of depression rose by 25% and that of anxiety by 27%, whilst in 2022, nearly half of young adults reported mental health difficulties (WHO, 2022).

This study presents the mental health, prevention, and sports programmes of the town of Csíkszereda as an integrated, system-level urban model that advances the development of sustainable communities by promoting mental and physical health. The study aims to demonstrate how complex interventions implemented at the local level contribute to strengthening social cohesion, educational outcomes and long-term urban sustainability.

Methods

The study employs a qualitative case study methodology. The analysis is based on documentation, programme descriptions, and aggregated participation data from mental health, prevention, and sports programmes implemented by the local government of Csíkszereda between 2022 and 2025, as well as structured participant feedback.

During the analysis:

- we mapped out the structural framework of the programmes,
- We identified the individual levels of intervention,
- presented the target groups reached and the coverage,
- and analysed the sustainability and community impacts of the programmes.

The programmes presented are preventive and community development in nature and do not constitute clinical research. In all cases, interventions

involving vulnerable target groups were carried out in accordance with current legislation and with institutional and parental consent.

Results

The local government of Miercurea Ciuc has established a four-tier mental health system based on educational institutions, whilst also extending to all age groups at the municipal level.

The first tier: support for school leaders and teachers.

The programme began by supporting the mental well-being of school leaders. Group and individual supervision, as well as leadership training, helped to bring about a change in mindset. Individual development opportunities became available to teachers, including supervision, stress-management techniques, and restorative communication methods. In 2022, 126 teachers took part in the programme, with 80% intending to continue.

From 2025–2026, as a new element, the entire teaching staff of two educational institutions will each year take part in institution-level restorative communication training, which aims to transform organisational culture.

Level two: developing children's coping skills.

The programme offers age-appropriate psychodrama and stress-management groups for primary, lower secondary, and upper secondary school pupils. The sessions aim to prevent anxiety, aggression and emotional overload. In 2024, 17 children will take part in the programme, and from 2025–2026, six groups of 25–35 children each will participate.

Level three: parental support.

From 2025–2026, structured parent groups will be launched to strengthen the parental role, resolve family tensions, and support physical and mental balance. The programme is based on the premise that a child's mental well-being is closely linked to their parents' mental state.

Level four: prevention and protection.

The school child protection programme covers all educational institutions in Csíkszereda. The programme aims to ensure that teachers, children and parents alike can recognise the signs of boundary violations and respond

appropriately in critical situations. As part of the programme, short films on abuse, suicide prevention and child protection, classroom theatre performances and guided professional discussions were organised.

Table 1. Intervention levels of the mental health programme in Csíkszereda

Level of intervention	Target group	Main methods
I. Level	Institutional managers, teachers	Supervision, leadership training, stress management
II. Level	Children	Psychodrama, coping skills development
III. Level	Parents	Group support, mental health education
IV. level	The whole school community	Child protection, prevention, awareness-raising

City-wide programmes and sport-based prevention

In addition to school-based interventions, Miercurea Ciuc also runs comprehensive mental health and health promotion programmes at the city level. The Cloud Youth Festival and the PszichoszerEda Festival raise the social profile of mental health. The anonymous 'Hallgatlak' counselling service, the 'Lélek' workshops run by the KALOT Association, and joint programmes with the RMDSZ Women's Organisation provide targeted support for various social groups.

Sport and exercise, as a means of prevention, feature in the school skating and swimming programmes, the Lábbusz programme, the FitSzereda fitness programme, the Running Festival, and the work of the Prevention Centre, which implements prevention integrated into primary care.

Summary

The Csíkszereda model demonstrates that supporting mental and physical health is not a supplementary element, but a fundamental prerequisite for sustainable urban development. Early prevention, a shift in institutional mindset, and strengthened community cohesion together yield long-term social and economic returns.

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Béla Bors

A GREEN FUTURE IN THE HEART OF SZÉKELY LAND: STEPS TOWARDS GREEN SUSTAINABILITY

Abstract

Green sustainability has become the overarching guiding principle of urban development in Csíkszereda, building on local social, economic, and natural conditions and aligning with European Union directives. In this context, sustainability does not primarily mean large-scale climate policy interventions. However, there are practical developments that improve energy efficiency, reduce environmental impact, create liveable public spaces, and enhance residents' quality of life. The city's geographical location, climatic characteristics, demographic structure and compact urban layout all determine the direction of sustainability efforts.

Strategic planning plays a key role in the city's development. Documents on energy, mobility, climate adaptation and integrated urban development provide a coordinated framework for long-term decisions. In the field of energy management, the use of renewable energy sources, building energy-efficiency upgrades, the modernisation of public lighting, and the development of the district heating system all contribute to more sustainable operations. In waste management, digital waste collection points, selective collection systems and the strengthening of public participation signal a new, data-driven and community-centred approach.

The development of urban green spaces fulfils ecological, recreational and community functions simultaneously. The expansion of the green space network, the use of the Central Park complex, and partnerships with civil society organisations also support environmental education and community participation. The development of green transport is based on the expansion of the cycle path network, lower-emission public transport, and programmes encouraging walking. The city's sustainability processes are based on community cooperation, local adaptation and measurable development outcomes.

Keywords: *sustainable urban development, energy efficiency, green transport, waste management, community participation*

Green sustainability is no longer a supplementary element but a fundamental prerequisite for responsible urban development in Europe. The European Union's development policy – particularly the European Green Deal and integrated territorial approaches – clearly sets out the direction that economic development, social well-being and environmental responsibility should reinforce one another in the day-to-day functioning of cities. In this sense, sustainability is not merely an environmental issue, but a long-term community investment.

In the case of a small town in Szeklerland such as Miercurea Ciuc, green sustainability takes on a specific meaning. Here, it is not large-scale climate policy interventions that dominate, but rather the everyday decisions that directly impact the population's quality of life. Sustainability primarily means investing in people: in a healthier living environment, well-designed public spaces, and institutions that fulfil community functions. At the same time, it is a technical and economic issue, as energy efficiency becomes a key concern in cold climates. Modernising buildings, adopting energy-efficient solutions and making better use of local resources serve both to protect the environment and to reduce households' utility bills.

Miercurea Ciuc's green sustainability efforts thus align both with European development trends and the real needs of the local community. The aim is not to copy ready-made models, but to develop solutions tailored to the city's scale, natural environment, and social structure. In this sense, green sustainability is not an end in itself, but a continuous process of learning and adaptation in which the city, its institutions and the population participate together.

Miercurea Ciuc – known in Romanian as Miercurea Ciuc – is situated in the heart of Eastern Transylvania, at the centre of the historic Székely Land. The town looks back on a history of more than six hundred years: its 14th-century roots, as well as the meeting of different cultures and traditions, continue to define its character and identity to this day. Its strategic location has ensured it a prominent role throughout history; it has functioned as a commercial and cultural centre, and its name derives from the markets held on Wednesdays. This historical background remains an important foundation for thinking about the town's future.

Geographically, Miercurea Ciuc lies in the heart of the Csík Basin, nestled between the Harghita and Csík mountain ranges of the Eastern Carpathians, at an altitude of 665-730 metres above sea level. The River Olt, which flows through the town, and the surrounding mountainous landscape represent not only natural assets but also significant resources. At the same time, the cold climate presents specific challenges, particularly regarding energy consumption and the sustainable operation of the building stock.

Administratively, Miercurea Ciuc is the county seat of Harghita County, covering an area of over 117 square kilometres. The overwhelming majority of the population is of Hungarian ethnicity, making the town one of the key cultural and social centres of Szeklerland. According to 2022 data, the population of Miercurea Ciuc is 34,484. The age distribution shows that the 40–49 age group is the largest, whilst the proportion of those aged 80 and over is the lowest. The proportion of the working-age population is 58.26%, slightly below the national average, whilst the proportion of the older age group exceeds the national average. These demographic characteristics make it particularly important to adopt urban development approaches that are sustainable in the long term and improve the quality of life for the population.

In terms of its settlement structure, Miercurea Ciuc has a compact town centre, surrounded by various residential areas in a ring-like pattern. Municipal institutions, cultural and commercial functions, and the most important public spaces are concentrated in the centre. This is surrounded by blocks of flats built during the socialist era, which remain the city's most densely populated areas and play a key role in the organisation of everyday services and urban life. In the outlying areas – such as Csíksomlyó, Zsögöd, or Taploca – suburban, detached housing dominates. These areas are currently undergoing intensive development through new residential districts, infrastructure investments and green space improvements.

The city's economic structure is based primarily on the service sector, light industry – particularly the food and textile industries – and the increasingly strong IT sector. Although the environmental impact of industrial activity is moderate, the obsolescence of heating systems and the increase in vehicle use continue to pose challenges for air quality. In addition, certain elements of the infrastructure – particularly the condition of the water network and the

flexibility of the transport system – also require development, primarily to strengthen sustainable modes of transport.

That said, Miercurea Ciuc also possesses significant potential in the field of green sustainability. The potential for geothermal energy utilisation, the presence of extensive green spaces, and an active, environmentally conscious local community create a foundation on which a sustainable, liveable urban model can be built in the long term. The city's geographical, social and economic characteristics thus form an integral part of an approach that views sustainability not as an isolated goal, but as a development direction that permeates the city as a whole.

Planning and strategies

Sustainable urban development is not a series of ad hoc interventions, but the result of a conscious, long-term planning process. A city can only develop consistently and predictably if its decisions are based on clear objectives, sound analyses and approved strategic documents. In the case of Miercurea Ciuc, strategic planning is particularly important, as environmental challenges, demographic changes, and economic transformations are all present simultaneously and can only be addressed through coordinated responses.

The urban development plans are based on several strategic documents that are consistent with one another. These not only provide direction but also set the framework for investments, the utilisation of grant funds, and local government decision-making. The most important strategic documents are as follows:

- Smart energy developments for a greener, more liveable future! – GreenSzereda
- Integrated Urban Development Strategy for Miercurea Ciuc and Functionally Linked Areas
- Sustainable Mobility Plan for Miercurea Ciuc and its catchment area
- Strategy and Action Plan for Climate Change Mitigation and Adaptation in the City of Miercurea Ciuc – CLIMADAPT

Together, these documents provide the technical and strategic foundation upon which Miercurea Ciuc's long-term, sustainable and community-centred development is built.

Energy management and energy efficiency

In recent years, Miercurea Ciuc has taken deliberate steps towards sustainable energy management. Renewable energy sources are playing an increasingly important role in the town, whilst residents and local businesses have also become more open to energy-efficient solutions. The use of solar energy, biomass, biogas and geothermal energy is not only beneficial from an environmental perspective, but also leads to long-term financial savings.

Solar energy is one of the fastest-growing renewable energy sources in Csíkszereda. In recent years, an increasing number of households and businesses have installed solar panel systems, thereby reducing their energy consumption and costs. Under the REPowerEU programme, disadvantaged residents can receive a non-repayable grant of up to €10,000 for the installation of solar panels and energy storage systems, with no upfront cost. The programme makes a significant contribution to the spread of renewable energy and to increasing the town's energy independence. This is complemented by the Casa Verde (Green House) programme, which also supports residents in implementing green energy investments.

Hargita County – and Miercurea Ciuc within it – has favourable conditions for using biomass and biogas for energy. By-products of agriculture and forestry, such as straw or sawdust, can serve as valuable energy sources whilst strengthening the local economy. These solutions also enjoy favourable social acceptance, as they are based on local resources and create jobs.

The use of geothermal energy is also becoming increasingly widespread, particularly in newly built residential properties. Thanks to national subsidy schemes, heat pump systems are appearing in more and more properties, providing heating efficiently and in an environmentally friendly manner whilst reducing running costs in the long term.

The local council has also carried out significant investments in public buildings. Energy-efficiency upgrades are underway or have already been completed in schools, nurseries, and cultural institutions with support from

the National Recovery and Resilience Plan (PNRR). The improvements include thermal insulation, replacement of windows and doors, and the installation of solar panel systems, reducing energy consumption and operating costs.

The city's street lighting has been almost entirely renewed: energy-efficient LED luminaires have been installed, which consume less energy and, thanks to their longer lifespan, result in lower maintenance costs. The city currently operates 3,725 luminaires, of which 2,456 are still conventional.

Special attention is also being paid to the thermal insulation of block-of-flats. Miercurea Ciuc is one of the coldest towns in Romania, where the heating season can last up to 7–8 months. Of the town's 308 blocks of flats, 158 are already partially or fully insulated, and several public buildings are undergoing thermal refurbishment.

The modernisation of the district heating system is also underway to increase energy efficiency, reduce emissions, and ease the burden on residents. The developments are being funded by European Union funds, state subsidies and local authority contributions, resulting in a more sustainable and resilient urban energy system in the long term.

Waste management on a new footing

Waste management is a key area for the city's sustainable operation, as it directly impacts the environment, public health, and the population's quality of life. For a modern city, the question is not only what happens to the waste generated, but also how to reduce its volume, increase recycling, and make the population active participants in this process. In recent years, Miercurea Ciuc has sought to bring about a shift in mindset in this area too: instead of traditional waste management, the focus has shifted to developing a more conscious, data-driven and community-centred system.

The developments in the town directly affect the waste management practices of more than 13,000 households. This means that the changes are not isolated investments but influence the habits, decisions, and environmental awareness of the population at the level of everyday life. The aim is to operate a system that is simultaneously efficient, transparent and incentivising.

One of the most important elements of this is the installation of digital waste collection points. A total of 104 digital waste collection points will be set up in Csíkszereda to support selective waste collection using modern technology. These systems not only make the urban environment tidier, but also provide more accurate data on the volume and composition of waste, which is essential for long-term planning and optimisation.

Alongside technological developments, encouraging public participation plays a key role. One tool for this is the free selective collection day organised monthly, which provides an opportunity for households to dispose of waste types that differ from the usual – such as larger quantities of recyclable materials – within a regulated framework. These events not only provide a practical solution but also play an important role in raising awareness.

As part of the expansion of selective waste collection, dedicated textile collection bins are also available in the town. The management of textile waste is becoming an increasingly significant challenge across Europe, which is why Miercurea Ciuc aims to implement responsible, circular solutions in this area too, thereby reducing the burden on landfills.

A remarkable statistic clearly illustrates the growing environmental awareness among residents: in 2024, the town collected 65,034 litres of used cooking oil. This figure is significant not only from an environmental perspective – as cooking oil severely pollutes soil and waterways – but also because it indicates that the public is open to new, responsible waste management solutions.

Waste management in Miercurea Ciuc is increasingly being placed on a new footing: technological developments, data-driven planning and community participation reinforce one another to contribute to a cleaner, more liveable urban environment. The aim is not merely to manage waste, but to foster an urban culture in which sustainability becomes a natural part of everyday decision-making.

Urban green spaces

The role of urban green spaces now extends far beyond their aesthetic function. Green spaces improve the quality of urban life, mitigate the local effects of climate change, enhance air quality, provide space for recreation, and strengthen community ties. In Csíkszereda, the development of green

spaces is a deliberate urban policy direction that serves environmental, social and health-related objectives simultaneously.

In recent years, the city's green spaces have been gradually expanding: from around 78 hectares previously to nearly 230 hectares. These green spaces are not isolated elements, but form a coherent, easily accessible network, linked to 56 playgrounds and 16 sports pitches. The aim is to create an urban environment that offers opportunities for active recreation and nature-based experiences for people of all ages.

Central Park best illustrates the multifaceted function of urban green spaces. The park is one of Miercurea Ciuc's most important community spaces, with roots dating back to the early 20th century; it has been listed in the register since 1935. It was established on a former marshy area where trees were originally planted to absorb water. Over the decades, whilst preserving the park's natural character, it has gradually evolved into a multifunctional, liveable public space.

The park's flora is extremely diverse: native and ornamental plants, along with carefully designed flower beds, ensure that a constantly changing spectacle greets visitors throughout the year. Furthermore, the park serves as an important habitat for numerous bird species. As a result of cooperation with the Green Székely Land Association, a birdwatching board aids environmental education, which features prominently in school programmes and the annual 'Green Weeks'.

Central Park is one of the main venues for community life: concerts, festivals, fairs, open-air theatre performances, sports and family events take place throughout the year. At the same time, it is a space for everyday recreation, featuring playgrounds, sports pitches, fitness and walking trails, cycle paths and drinking fountains. Inclusivity is a key consideration in the park's development: by expanding the footpaths and rest areas, we aim to make it easily accessible to everyone.

Partnerships with civil society organisations play a key role in maintaining and developing green spaces. As part of the TREES project, implemented in collaboration with the Project Bag association and funded by the Norwegian Fund, a green register has been created, a detailed survey of 500 special trees

has been carried out, and a smartphone app has been developed to strengthen cooperation between the public and the local council.

The work of the municipal horticultural department provides a solid professional foundation for all this. Every year, 250–300 new trees and several thousand shrubs are planted, with three trees planted to replace every one felled. There are more than 14,500 trees in the town, including protected specimens that are nearly a century old. In the spirit of sustainability, recycling green waste, composting, and minimising chemical use are everyday practices. All this clearly demonstrates that in Csíkszereda, green spaces are not merely decorative elements, but key pillars of the city's liveability and the future of its community.

Green transport

The transformation of urban transport is a key element of Miercurea Ciuc's sustainable development. Green transport solutions not only help reduce environmental impact, but also create a more liveable and healthier urban environment, whilst offering an alternative to private car use. Shaping transport habits is a long-term process that requires infrastructure development, a shift in mindset and community cooperation.

With this in mind, a comprehensive plan has been drawn up in Miercurea Ciuc to develop a cycle path network spanning nearly 25 kilometres. The concept involves not only the construction of new sections, but also the renovation of existing cycle paths and the linking of individual sections to create a coherent, safe and user-friendly system. The aim is for cycling to become a genuine alternative for everyday travel, particularly for shorter urban journeys.

Significant progress has also been made in the field of public transport. The backbone of the city's public transport system is currently a fleet of 23 buses running on compressed natural gas (CNG), which operate with significantly lower emissions than conventional diesel buses. The steady increase in passenger numbers shows that more and more people are choosing environmentally friendly public transport for their daily journeys.

Green transport is not just a technical and infrastructural issue, but also a matter of changing attitudes. This is the aim of the Lábbusz programme, under which adult volunteers accompany children on foot to school in the mornings,

following pre-determined routes and stops. Around 150–200 children take part in the programme every day, covering an average of 1,400 kilometres on foot over the course of a year. The initiative operates across the city and not only helps to reduce traffic but also lays the foundations for an openness to a healthy, active lifestyle from a young age.

In Miercurea Ciuc, more and more people are using environmentally friendly transport options. The conscious promotion of cycling, public transport and walking contributes to the creation of a quieter, cleaner and more people-centred city, where transport is not just a means of getting from A to B, but becomes a defining element of everyday quality of life.

Community effort – feedback

A city's development is measured not only by the investments and strategies implemented, but also by how its residents and external observers perceive them. Feedback is particularly important because it confirms that the city is heading in the right direction, whilst also guiding further development. For a municipality, this feedback serves as confirmation that community efforts and local government decisions are genuinely improving the quality of life.

In the case of Miercurea Ciuc, several independent assessments have positively validated the work carried out in recent years. According to Storia's national survey, the town has become Romania's third cleanest county seat, clearly reflecting the shared commitment of the population, the local council, and service providers to maintaining a tidy environment. This result is not the consequence of a single measure, but the outcome of a long-term, consistent approach.

Equally telling is the City Index ranking, which placed Miercurea Ciuc as the 13th most liveable city among 41 county seats in Romania. This recognition is based on a complex set of criteria and takes into account factors such as the quality of the environment, the standard of public services, transport, and the condition of public spaces.

Among the international accolades, the result achieved in the 2024 Entente Florale Europe competition stands out. Miercurea Ciuc received prestigious European recognition, with the jury particularly highlighting the town's green space management practices, the community's active involvement in

beautifying the environment, and the exemplary cooperation between the local council and civil society organisations. This feedback clearly shows that community cooperation and conscious urban development yield tangible, measurable results.

Summary

The aim of the paper 'A Green Future in the Heart of Szeklerland: Steps Towards Green Sustainability' was to provide a comprehensive overview of Miercurea Ciuc's efforts towards environmental sustainability, liveability and community responsibility. The chapters clearly demonstrate that the town's green transition is not the result of isolated projects but a process built on conscious planning, partnerships, and long-term strategies.

The example of Miercurea Ciuc clearly illustrates that even a medium-sized town with specific social and geographical characteristics can provide effective responses to the environmental challenges of the 21st century. Energy-efficiency investments, the increasingly widespread use of renewable energy sources, the modernisation of public institutions, and support programmes encouraging public participation all contribute to reducing energy dependence and promoting sustainable operations.

The overhaul of waste management, the introduction of digital solutions, and efforts to shape public attitudes demonstrate that the city is addressing sustainability not only on a technical level but also on a social one. Urban green spaces play an equally important role, serving ecological, recreational and community functions simultaneously. The example of Central Park illustrates how a green space can become a defining feature of urban life, where environmental protection, community building, and cultural life reinforce one another.

The development of green transport solutions – the expansion of the cycle path network, environmentally friendly public transport and community programmes such as the 'Walking Bus' – further reinforces the view that sustainability can be understood at the level of everyday decisions. All of this is underpinned by a strategic approach that grounds urban development in integrated documents, long-term goals, and measurable results.

Feedback and national recognition – whether in the form of cleanliness rankings, liveability indices or international competitions – confirm that green initiatives based on community cooperation deliver tangible results. Miercurea Ciuc's green future is therefore not a distant vision but an ongoing process in which the local council, civil society, economic actors, and the local population are jointly shaping a sustainable future for the heart of Szeklerland.

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Andrej Ozimy

THE PAST, PRESENT AND FUTURE OF THE KOMÁROM FORTRESS

Abstract

The Komárom Fortress is one of the largest and best-preserved fortress systems in Central Europe, having played a decisive military, strategic and historical role for centuries. The complex comprising the Old Fortress and the New Fortress was established in the 16th–17th centuries and, in the 19th century, developed into one of the most significant fortress systems of the Austro-Hungarian Monarchy. Its history clearly reflects the political and military changes in Central Europe, from its role in defence against the Turks, through the Napoleonic Wars and the events of the 1848–49 War of Independence, right up to its use by 20th-century armies. Following the cessation of its military function, the fortress entered a new era, centred on the restoration of the historic monument, the preservation of cultural heritage and community use. During the gradual renovation of the site, which has been in municipal ownership since 2003, particular emphasis was placed on preserving historical values, making the buildings accessible to visitors and developing new functions. As a result of the restoration, exhibition, conference, tourism and cultural spaces have been created, whilst a significant part of the fortress still awaits further development.

A key element of this utilisation is multifunctional operation, which combines tourism, cultural programmes, education and community participation. Organised guided tours, themed events and historical presentations contribute to the fortress becoming an important venue for local identity and heritage awareness. The growing number of visitors indicates that heritage conservation, the sustainable use of cultural heritage and community involvement function as mutually reinforcing processes. The example of Komárom Fortress demonstrates that the preservation of historic built heritage can play a decisive role in the cultural, social and economic dimensions of sustainable development.

Keywords: *Komárom Fortress, cultural heritage, heritage conservation, sustainable use, historical memory*

Introduction

Komárom Fortress is part of one of Central Europe's best-preserved and most extensive fortress systems. The complex comprising the Old and New Castles, collectively known as the Central Fortress, is situated in North Komárom, at the confluence of the Danube and Váh rivers, at the easternmost tip of the Csallóköz. Its oldest part, the so-called Old Castle, was built in the 16th century on the site of the former medieval castle and King Matthias's Renaissance palace. In the 17th century, it was expanded with the so-called Újvár, which occupied the site of the medieval town. Following two powerful earthquakes that struck in the 18th century, the fortress lost its military character. However, following the military victories of the French Emperor Napoleon I, it was renovated and expanded at the beginning of the 19th century, thus becoming the largest fortress system of the Austro-Hungarian Monarchy, capable of accommodating an army of up to 200,000 men if necessary. The Fortress retained its military character even after the collapse of the Monarchy, until 2003, when it became the property of the City of Komárom. Since then, the Fortress has been gradually restored, and its gates are open to the public year-round.

From the history of the Central Fortress

The first fortification was built in the mid-16th century on the site of the medieval castle and the Renaissance palace of King Matthias I, serving as a frontier fortress against the Turks. Emperor Ferdinand I of Habsburg invited numerous Italian engineers and master builders to the Kingdom of Hungary to design and construct modern fortifications – forts, fortified towns and fortification systems – throughout the country. The Italian Pietro Ferabosco is considered to be the architect of Öregvár, but several other Italian architects also took part in its construction. During construction, the fortress was hit by a flood, which caused part of the walls to collapse. The fortress was finally completed only at the end of the 16th century.

At the end of 1594, the Old Fortress faced its greatest test when the Ottoman army besieged it for several weeks, though unsuccessfully. The fortress withstood artillery fire and direct assault, demonstrating its well-thought-out, professional construction.

As the Ottomans advanced deeper into Hungary along the Váh River, Emperor Ferdinand III decided to expand the Komárom fortress, and in the mid-17th century, construction began on the so-called New Fortress on the site of the destroyed town. Due to a lack of funds and building materials, and the need for rapid construction, only one bastion and the entrance section of the New Fortress were built of solid materials (brick and stone). The remaining bastions and connecting walls were constructed from earth.

Both forts were surrounded by moats, which could be filled with water from the Danube if necessary. Inside the fort were numerous buildings of various kinds, constructed from solid materials or wood. Each fort contained barracks, storehouses, stables, churches, and accommodation for soldiers' families and other personnel.

After the expulsion of the Ottomans, the fortress lost its role and became redundant, but its military function was not discontinued. It was partially restored during the War of the Austrian Succession. In the second half of the 18th century, it was struck by two powerful earthquakes. Although its walls and internal buildings were restored, Emperor Joseph II decided to abolish its military function. The soldiers were withdrawn, the Fortress was divided into plots, and its buildings were sold at public auction. Consequently, the people of Komárom dismantled parts of it and used the building materials to construct their own houses in the town.

The expansionist policies of the French Emperor Napoleon I characterised the early 19th century. As a result, the Austrian imperial court was forced to leave Vienna, and Emperor Francis I himself stayed in Komárom for several weeks. It is said that during one of his visits to the town and the fortress, he expressed his wish that a system of fortifications be built in Komárom on both banks of the Danube and Váh rivers, capable of providing shelter, if necessary, for the entire imperial court and an army of 200,000 men, fully equipped and with food supplies.

Thus began the restoration of the Old and New Castles. Between 1809 and 1810, a huge barracks building, 540 metres long, was constructed; in 1815, the Command Building was built; and between 1827 and 1839, the Old Castle was renovated and rebuilt. This resulted in the creation of modern accommodation and storage facilities.

Between 1839 and 1848, under the supervision of Palatine Joseph, a series of so-called ‘werkes’ or bastions were built behind the town, completely encircling it from the south-west to the north and south-east. On the right bank of the Danube and the left bank of the Váh, identical star-shaped fortifications with four bastions were built, connected to the Old Fortress by pontoon bridges.

Construction was interrupted by the outbreak of the Hungarian Revolution of 1848–49. At this time, command of the Fortress also changed, with a Hungarian commander taking charge of the Komárom Fortress and its garrison for the first time since the 16th century. The Austrian command and soldiers, who were unwilling to support the Hungarian national liberation movement, were forced to abandon the Fortress and the town. However, they did not leave this unanswered, and in early 1849, they began bombarding the town from the right bank of the Danube. Their aim was not to destroy the hard-won fortifications, but to target the civilian buildings within the town and force the town’s defenders to surrender. The Hungarian troops, however, managed to break through the Austrian siege in several battles and secure vital supplies and military booty, though they were unable to defeat the enemy army. The defenders of Komárom, however, were steadfast and did not give up. They believed in the revolution's victory, and even after the forced surrender of the main Hungarian army at Világos, they did not give up, successfully defending their town and fortress. It was only the decision of General György Klapka, who had negotiated very favourable terms for his soldiers, that led to the surrender of arms and the handover of the fortress system to the Austrian command in early October 1849.

After the suppression of the revolution, construction of the fortification system resumed where it had left off. In addition to repairing the damage, new forts were also built. Between 1850 and 1871, the so-called Monostori Fort, the largest in the entire system, was built on the right bank of the Danube, west of the village of Új-Szőny. Between 1866 and 1872, the Nádor Line was connected to the Central Fort via the so-called Vág Line, which ran along the banks of the Vág; and between 1871 and 1875, the so-called Igmándi Fort, the southernmost and smallest of the system, was built (Figure 2).

This is how the fortification system came into being, with a perimeter of 16 km, a built-up area of approximately 50 hectares, and a total area owned and used by the army of around 900 hectares.

Before the outbreak of the First World War, various plans were drawn up for the further expansion of the system, but of these ambitious plans, only three smaller reinforced concrete fortifications were realised, serving to protect the railway bridges over the Danube and the Váh.

Following the collapse of the Monarchy and the establishment of Czechoslovakia, the town and the fortification system were divided into two. The Czechoslovak army occupied the northern part in early 1919. The Central Fortress, along with some other parts of the fortification system, remained in use until 1938, when Komárom was returned to Hungary. After the Second World War, the Czechoslovak army returned to the fortress, but in 1968 it had to hand it over to Warsaw Pact troops.

Soviet soldiers quickly occupied the fortress and carried out various alterations. Unfortunately, their actions led to the destruction of many historically and architecturally significant parts of the building. Around 5,000–6,000 Soviet soldiers were stationed at the Fortress, who viewed it not as a cultural monument but as a military facility. For example, the moat surrounding the Old Fortress was filled in. Slovakia's largest ammunition depot was established in the Old Fortress, and it was even used for waste storage. They feared that the size of the garrison could be calculated based on the volume of waste. During their occupation, for example, they created a huge parade ground and painted all the buildings red.

In 1990, an agreement was reached between Czechoslovakia and the Soviet Union regarding the withdrawal of the Soviet army. The Soviet army left the Fortress in November. After their departure, the Fortress was used by the Czechoslovak and Slovak armies until 2003, when the Komárom military garrison was disbanded and the Fortress became surplus state property. The state therefore put it up for sale, and Komárom Town Council decided to purchase the Fortress, which eventually took place. The intention was to move the recently established Selye János University into the Fort, but the idea was rejected due to strict heritage protection regulations and the demanding nature of the renovation work.

Restoration of the Fort

The most important task following the purchase of the Fort was its restoration to a condition in which it could be opened to the general public. It was necessary to secure the buildings' entrances to prevent unauthorised persons from entering the Fort, to remove large quantities of military waste, and to commence the most essential repairs.

First, the gunpowder store was renovated between 2005 and 2007, creating a space suitable for exhibitions and conferences.

Between 2010 and 2014, the Ferdinand Gate of the Old Fortress was restored, and in 2013, the Leopold Gate of the New Fortress (the main entrance to the Fortress) was restored.

Between 2015 and 2022, the roof of the barracks building, over 500 metres long, was completely renovated. This has been the most comprehensive renovation to date.

Between 2021 and 2023, thanks to EU funding, a new office and ticket office were established, along with toilets and an exhibition hall for visitors to the Fortress within the barracks building; furthermore, the building's 70-metre-long façade was renovated, and a new transformer station was built to facilitate the Fortress's further development.

Alongside the local council, other non-profit organisations and civil associations are also renovating parts of the Fortress. This includes the refurbishment of the central section of the barracks building, where a small accommodation facility, a wine bar and a conference room have been established, as well as a craft brewery producing five types of beer. The Komárom Cartwrights' Traditionalist Association uses three rooms, and work is currently underway to create a beekeeping museum and a lecture hall.

These renovation works account for only a fraction of the Fort's total 13-hectare area; more than 600 further rooms are still awaiting restoration and meaningful use.

Presentation and promotion of the Fortress

The Fortress has been owned by the City of Komárom since 2003. In the same year, the local council established a non-profit organisation called Pro Castello

Comaromiensi to manage, promote and renovate the Fortress. Between 2003 and 2019, its director was Lajos Gráfel, a heritage conservationist and employee of Komárom Town Hall; since 2019, the director has been Andrej Ozimy, a museologist.

The primary aim of the non-profit organisation was, and remains, to promote the Fortress and make it accessible to the public through organised guided tours. In addition to daytime tours, we have been organising evening and night-time tours for several years now. Our Old Fortress Day event is also very popular, packed with a varied cultural programme for all ages. This day, which concludes with a re-enactment of the battles of the 1848–49 Hungarian Revolution and War of Independence, commemorates the first Battle of Komárom on 26 April 1849. On this day, we also hold a 19th-century open-air cooking competition. In addition, we organise Second World War re-enactments, as well as spooky and fun Halloween fortress tours (Figure 3).

The renovated Gunpowder Store building has recently been hosting an increasing number of conferences, specialist lectures, and other cultural events for all age groups. The building is also popular for hosting private events and weddings.

The fortress is open to visitors year-round. Guided tours depart three times a day and are led by knowledgeable guides. Depending on the group, the tour lasts 1–1.5 hours and covers approximately 1.5 km. During the visit, visitors receive an explanation of the fortress's extremely rich history in Slovak, Hungarian, English or German. Visitor numbers have fluctuated over the years (Table 1).

Table 1. Visitor numbers at the Fortress over the past six years.

2020	2021	2022	2023	2024	2025
8447	9083	11,779	11,461	14012	16353

The restoration and utilisation of the Komárom Fortress is not only of outstanding importance from a cultural and tourism perspective, but is also closely linked to one of the key dimensions of sustainability: the preservation of cultural heritage. Preserving the historic built environment and infusing it

with new functions contribute to the conscious and responsible use of resources by building on the reuse of existing infrastructure rather than requiring new investments. This approach is not only environmentally beneficial but also more economically sustainable, as it reduces construction costs and environmental impact.

In the case of the fortress, community involvement and multifunctional use play a particularly important role, combining tourism, education and cultural programmes. Developments of this kind not only increase visitor numbers but also strengthen the local community's identity and connection to its historical heritage. The active use of cultural spaces creates an opportunity to integrate the values of the past into present-day social and economic processes.

Moreover, the example of the Komárom Fortress also highlights that heritage conservation and sustainable development are not conflicting objectives, but can be understood as mutually reinforcing processes. The preservation of historical heritage not only honours the past but also contributes to creating an environment that is meaningful and liveable for future generations. Such heritage-based developments thus represent not only cultural value but can also become important tools for sustainable thinking and social responsibility.

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Tamás Baranyai

THE LANGUAGE OF SUSTAINABILITY – HOW DOES SCIENCE SPEAK ABOUT THE WORLD?

Abstract

The language of sustainability is not merely a tool for describing reality but also a shaper of it: the mode of scientific discourse directly impacts how society interprets and addresses global challenges. Science traditionally speaks the language of objectivity and precision, yet this form of communication often struggles to connect with social action. At the same time, the simplistic, emotionally charged, and self-assured narratives of pseudoscience become more readily accepted, whilst the line between credible knowledge and disinformation blurs. Pseudoscientific discourse is particularly strong in the social media environment, where opinions appear to be on an equal footing and the practice of 'do-it-yourself research' relativises expert knowledge. This process contributes to the erosion of scientific authority and leads to social consequences such as anti-vaccination sentiment or climate scepticism. The communication of scientific uncertainties – for example, in the form of probabilistic statements – is easily manipulated, which can lead to delayed decision-making and a failure to take collective action. The psychological dimension of this phenomenon is described by 'change blindness', whereby gradual environmental deterioration goes unnoticed as individual perception adapts to the new state. This mechanism further hinders the recognition of sustainability issues and the understanding of their urgency. Science communication must therefore fulfil not only an informative function, but also an interpretative and awareness-raising one.

Sustainable science communication requires a mediation system capable of conveying technical language in a form that is understandable and relevant to various actors in society. In this process, science appears not merely as a source of information, but as a common language that can facilitate social dialogue and action.

Keywords: *science communication, pseudoscience, climate scepticism, disinformation, sustainability*

Introduction

When we talk about sustainability, we are not merely communicating data about the world; we are also shaping that world. The language of science has traditionally sought objectivity and precision, yet in the age of the global ecological crisis, it faces new challenges. How does raw data become a narrative that urges action? Sustainability is no longer merely a biological or economic concept, but the common language of the 21st century – but do we understand one another? Science often retreats behind the cold wall of facts, whilst the world needs understandable answers and shared stories. In this publication, I examine how scientific or pseudoscientific discourse shapes our view of the world, and whether our current terminology is sufficient not only to describe change, but also to facilitate it.

Cognitive short-circuit: the emptiness behind the façade of scientificity

One of the most important characteristics of pseudoscientific phenomena is their fondness for using expressions that sound scientific but lack substance (e.g. quantum energy detoxification, vibration frequency), thereby blurring the line between genuine research and marketing myths for the lay observer (Scheufele et al., 2021).

The trap of democratised truth

This pseudoscientific tool is most evident on social media. In the age of social media, every opinion appears to be of equal standing. Pseudoscience creates the false impression that 'do-it-yourself research' (a few Google searches or the use of Artificial Intelligence, or even citing 'scientific' gurus) is equivalent to decades of professional work. This undermines scientific authority.

The 'greyness' of science vs the 'colours' of pseudoscience

Real science is cautious, full of statistical probabilities and "if-then" conditions. Pseudoscience, by contrast, promises 100% certainty and immediate solutions. This contrast makes science appear slow and uncertain to society.

Social consequences

Pseudoscientific activities have far-reaching consequences. This is not merely a theoretical problem. When society loses its compass between truth and fabrication, it poses a direct threat.

Public health crises: Anti-vaccination The myth linking the MMR vaccine to autism is the root cause of the modern anti-vaccination movement. In 1998, British doctor Andrew Wakefield published a study in the renowned medical journal The Lancet, in which he claimed there was a link between the MMR vaccine and the development of autism (Rao & Andrade, 2014). It later emerged that Wakefield had falsified the data and breached ethical guidelines (he had a financial interest in promoting an alternative vaccine). In the UK, some vaccines are recommended but not compulsory; they are available voluntarily. The WHO officially announced in 2026 that the UK had lost its measles-free status.

The return of measles outbreaks is a sad reminder of the activities of anti-vaccination movements. In Samoa, two infants died as a result of a vaccine being administered incorrectly (human error), and rumours spread on social media that the vaccine was toxic. Vaccination coverage fell dramatically to around 30%, followed by a major measles outbreak in which more than 80 people, mostly young children, died (Qua net et al., 2020).

Climate scepticism is the disregard of the scientific consensus, which is not merely one opinion among many, but one of the greatest linguistic and strategic barriers to sustainability (Leka & Furnham, 2024).

Modern climate scepticism no longer states outright that global warming is not happening; instead, it employs the language of delay. Consequently, decision-makers become uncertain, and strategically vital investments are not made. With every year lost, the cost and difficulty of future adaptation increase exponentially.

The language of science speaks of probabilities (e.g. there is a 95% chance that…). Sceptics exploit this remaining 5% to heighten social uncertainty and portray the situation as if there were a debate amongst scientists (Gordin, 2017). As a result, society perceives that experts disagree, and the public remains passive.

The issue of climate change has now moved beyond the realm of natural science and into the realm of identity politics. Rejecting climate action, much like anti-vaccination sentiment, represents for many the defence of freedom or a traditional way of life. Scientific arguments are seen as an 'ideological attack' by sceptics, which erects a barrier between science and society.

If a significant proportion of a society is sceptical, this reduces the market power of green innovations. Companies become less motivated to develop sustainable technologies.

The most dangerous effect of climate scepticism is not the denial of facts, but the shattering of a shared vision of the future. When pseudoscience challenges evidence-based truths, it not only undermines the authority of science but also robs the community of the time to act. In this environment, the language of sustainability finds not resonance, but noise.

From a geopolitical perspective, science can be defined as a weapon, and pseudoscience as part of the geopolitical arsenal (Gertrudix et al., 2024). The 'chaos narrative' is the export of mistrust. Certain geopolitical actors have recognised that a country can be defeated not only with missiles, but also by shattering the shared perception of reality.

The way it works is very simple Bot farms and influencers supported by foreign states do not necessarily spread lies, but rather present a variety of contradictory information. The average citizen does not know whom to believe, so ultimately, quite conveniently, they believe no one, or accept the perceived truth that is simplest and easiest for them to accept.

Linked to the previous point, the funding of climate scepticism is often a matter of geopolitical interest. If a major power's economy is built on fossil fuels, it is in its vital interest to use pseudo-scientific arguments to slow down the green transition in the rest of the world.

Pseudo-science is the Trojan horse of modern politics: it uses the respectable language of science to undermine faith in objectivity from within. In this game, 5G and viruses are merely pawns on the political chessboard.

The reality of blindness to change

Why can't we see the disaster?

Change blindness is essentially a psychological concept, but it is also used in ecology (Sverdup-Thygeson, 2022). It is a phenomenon whereby an observer fails to notice a significant change in their visual environment.

The consequence of change blindness is the shifting baseline syndrome.

Environmental degradation rarely happens overnight. Even when science presents drastic data, our individual perception becomes accustomed to the deterioration.

For one generation, a meadow teeming with insects is the norm. The next generation sees a dwindling environment where diversity is waning; for them, this becomes the baseline, so they do not even recognise the loss.

Our brains are wired to seek stability and move in the direction where they perceive it to be.

The reality of this blindness to change is that we do not act not because we do not want to, but because our eyes and minds have become desensitised to destruction. The task of the language of science in this context is nothing less than restoring our vision; we must break through the threshold of perception before the change becomes irreversible.

SUSCOMNET as the language of science

An ecosystem of sustainable science communication, where translators (the communicators) are professionals capable of translating the rigorous language of science into the language of local communities, economic actors and political decision-makers.

Participants in the SUSCOMNET programme do not merely engage in discourse about science; they converse with the world about the world. This series of conferences acts as an 'antidote' to disinformation and cognitive blindness. If science can understandably articulate scientific algorithms, then sustainability will not be a distant utopia, but the common language of our everyday reality.

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Balázs Nagy-Laczkó

OLD OAK TREES AND YOUNG ELM SAPLINGS: LOCAL ACTORS' POSSIBILITIES AND RESPONSES TO URBAN TREES IN BÉKÉS COUNTY IN THE CONTEXT OF CLIMATE CHANGE

Abstract

Békés County is the region with the fewest trees in Hungary, and trees therefore play a particularly significant role in both local identity and collective memory. We can see that certain trees fulfil functions similar to those of monuments. Due to climate change and other human-induced changes in the region, some trees have recently become endangered, begun to decline, or have disappeared altogether. Local government actors, as key local stakeholders, respond to these phenomena in ways that often reflect their institutional roles, yet at times take on distinctive, context-specific forms.

In the initial phase of my research, which adopts a primarily cultural anthropological perspective and an interdisciplinary methodology, I examine the issues identified by local stakeholders and, in this paper, relate the cases of specific settlements to these issues. After presenting these practices, I use case studies to explore how the relationships among trees, local identity, spatial appropriation, and tourism may highlight the need to place greater emphasis on human-environmental research in local ecosystem studies in the future.

Keywords: *local identity, collective memory, climate crisis, climate change, natural heritage, ecotourism, eco-anthropology, urban ecology, local land use, human environmental studies*

Field

Just 4.6% of Békés County can be considered a forested area (Central Statistical Office, 2023). Precisely because of their scarcity, trees are defining spatial elements of the urban environment. In my work, I examine the relationship between local identity, memory, and trees, including the role of individual trees in preserving memory, the practices of preserving trees that contribute to local identity, and the practices accompanying their loss (Nagy-Laczkó, 2025a; 2025b, 2025c).

Methods

I conduct the research from a cultural anthropological perspective, using an interdisciplinary methodology (cf. Virág, 2007; Virág et al., 2007; Dümplemann, 2019).

I am examining the relationship between locals and trees in 22 settlements in Békés County, following George Marcus's advice to investigate the same question across several places simultaneously and then compare the results (quoted in Feischmid, 2007, p. 225; cf. (Nagy, 2015, p. 46). I am conducting joint field visits with local and municipal decision-makers and urban stakeholders, during which I will gain an understanding of these actors' decision-making processes regarding the tree populations in urban public spaces, the background to these processes, and the ideas and possibilities of decision-makers and implementers in light of the weather changes of recent years.

During the interviews, I established direct contact with the informants. I agree with Thomas Hylland Eriksen that an anthropologist must spend a long time in the field for their presence to feel natural to the informants (2006, p. 41). Throughout both the observations and the interviews, in order to maintain trust, I kept in mind that, as note-taking typically disrupts our surroundings, it is best to use it only once a relationship of trust has been established (Letenyei, 2005, p. 91). To establish and maintain this relationship of trust, I am currently relying primarily on my field diary in this research.

In my practice, observation rarely occurs separately from conversations with informants. A significant proportion of the conversations take place whilst out in the field, so the informant can draw attention to what they consider the subject of observation. My experience has shown that a more relaxed and comfortable atmosphere is created with informants if I alternate between semi-structured and unstructured interviews, using the latter primarily after establishing contact and the former increasingly during joint fieldwork (cf. Kaschuba, 2004, pp. 179–181; Letenyei, 2005, p. 158; Kovács, 2007, pp. 269–270; Mester, 2007, pp. 308–311; Bindorffer, 2008, pp. 62–63; Majoros, 2010, pp. 106–107; Mészáro,s 2010, p. 182).

In the spirit of reciprocity, I endeavoured during the research to ensure that local authorities could also make use of the findings (cf. Goffman, 1989, p,

cited in Durst, 2012, p. 102). From early 2025, I shared with several local authorities the practices deemed effective, proven, and beneficial by my informants; the various attempts at solutions; and the experiments considered unsuitable for the region, based on the experiences of individual local authorities.

In this paper, I focus on these practices, whilst discussing local individual and community practices relating to individual trees and tree groves (cf. Szelekovszky, 2000; Takács, 2014; Szallerné et al., 2020, p. 162), and the role of trees in historical and cultural heritage, as well as in local memory, is discussed in greater detail in "Living Mementos? Community Practices Related to the Loss of Trees with a Memory-Preserving Role in Békés County" (Nagy-Laczkó, 2025a).

Drought

Issues related to climate change are increasingly coming to the fore in discourse across the natural and social sciences. The study of urban trees is no exception to this. For example, whilst Le Roux and his colleagues investigated the survival and sustainability of old trees in Australian urban environments in the 2010s in relation to climate change (2014), Nathan G. Phillips and his colleagues investigated how rising carbon dioxide levels in the air have influenced and continue to influence the survival of old trees in the past and future (2008).

Based on the climate models available to us, a decrease in summer rainfall is expected in Central and Eastern Europe. Furthermore, regarding the spatial distribution of temperature increases, the various projections agree that greater warming is to be expected in the eastern and southern parts of the country (Dunkel et al., 2018, pp. 266–269). The fact that numerous environmental hazards, such as drought, inland flooding and wind erosion, are causing increasingly significant environmental, economic and social problems can be partly attributed to climate change. Of these, drought is one of the most significant environmental hazards in Hungary, occurring on average every 3–5 years, with both its frequency and severity having increased in recent decades (Mezősi et al., 2017, p. 60). Recent summer droughts have particularly affected the Körös Plain among Hungary's micro-regions. "Due to the increasingly severe precipitation deficit of around 200–300 mm on

average in the area between the Körös and Maros rivers, the drought is becoming ever more acute" (Kocsis et al., 2018, pp. 95–97).

Climate change also affects local perceptions, a fact recognised by domestic social research on the natural environment – even if trees have so far played only a marginal role in the research questions posed (cf. Babai, 2021). Yet dead trees are particularly striking and clearly visible manifestations of the current climate crisis, especially in a region that is already tree-poor, such as the area covered by our study.

Regarding perceptions of drought, local authority representatives offered insightful comments during the interviews. Local government officials have concrete experience with which tree species are affected by the environmental changes taking place in the region, to what extent, and what impact these changes will have on the future. They recognise the crisis nature of the situation. Consequently, local authorities are endeavouring to anticipate these changes within the limits of their available resources.

Organisation

The manner in which responses to weather-related issues in recent years are formulated is strongly influenced by the individuals serving as local government decision-makers.

The vast majority of settlements in Békés County cannot rely on their own horticultural specialist(s) when carrying out tasks relating to trees within built-up areas. Typically, when weighing up and making decisions regarding trees in response to various reports from residents, the decision-maker is unable to consult a suitably qualified colleague within the local authority, and thus relies on their own expertise, experience and commitment. Under these circumstances, local government decision-makers endeavour to resolve minor issues independently and consult external experts only in exceptional situations. In most cases, the identity of the expert depends on the decision-makers' personal network of contacts. It is more favourable when the operational staff of the local authority in question (typically within the city management department) include experts who are suitably qualified in relation to trees. These experts are typically the heads of the relevant departments or the managers of the limited liability companies entrusted with city management tasks. In such cases, whilst decisions regarding trees

generally fall within the remit of the town clerk, these stakeholders may make proposals and are involved in the decision-making processes. At the same time, in most towns where the head of city operations is a suitable specialist, tree-related tasks constitute only a part of their remit; so, alongside the day-to-day urban management tasks that take precedence in the city's daily life, their tree-related activities are limited to immediate problem-solving and the prevention of hazardous situations. A contributing factor to this workload is that, in most cases, a single specialist at these local authorities is responsible for both coordination and operational tasks, without the support of specialist colleagues.

In the most fortunate local authorities, both coordination and operational tasks are carried out by appropriate specialists. The small number of local authorities in this category typically have a chief gardener in addition to the gardener(s) who carry out operational activities. In the latter cases, a separate department is organised to coordinate horticultural tasks (including tree care), with a dedicated officer often overseeing the execution of individual sub-tasks. It is no coincidence that these favourable conditions are found where tourism represents a key value in the life and economy of the settlement. In these settlements, the local council recognises the economic potential inherent in tree management and, as a result, has the necessary financial resources to provide the required support.

Species selection

The knowledge and sources of information of decision-makers often come to the fore during new plantings and replacements.

The choice of species is often a planning decision, particularly for public space developments and renovations funded by grant schemes. In such cases, the species are usually selected by designers based in the capital, who, according to data providers, generally lack adequate local knowledge of the public's use of the space, the settlement's environmental conditions, or the practical possibilities for maintenance.

In those cases where variety selection does take place locally, adherence to tradition is generally a decisive factor, with the varieties they refer to as 'landscape varieties' (Bodrogközy, 1974, pp. 85–98; Kertész, 2006, p. 3; Bánfi, 2010, p, p. 4; Deli et al., 2015, pp. 8–13), citing the need to preserve the town's

existing character, the settlement's sense of identity, and the 'native population's' sense of belonging.

Ferenc Gereben sees one of the key characteristics of a sense of identity in the striving for survival and the preservation of features deemed essential (1998, p. 95), endeavours which can be observed in the attachment to species considered indigenous and native to the region (Nagy-Laczkó, 2025a; 2025b). The practices associated with these trees, as representations, express the actions of those who plant and tend them. Kincső Verebélyi highlights the erection of memorials as such an act (2005, pp. 27–28), but in many cases the trees themselves take on a role similar to that of memorials (Nagy-Laczkó, 2025a; 2025b).

At the same time, the actors themselves recognise that clinging to these traditions often results in dead tree-lined avenues and botched replanting schemes. However, following recent experiments, local government actors now have their own experience to draw on regarding which species will survive.

Choosing a nursery

The planting of trees and tree-lined avenues is typically (or can be) carried out using grant funding available nationwide. The exception to this is barely a quarter of the municipalities examined: those mentioned in the previous point, which have their own head gardener and horticultural department, and where tourism plays a defining role. However, none of the latter has their own horticultural facilities, and even where they do, these facilities are primarily used for growing annuals; only in exceptional cases do they involve the pre- and post-cultivation of seedlings or the operation of their own nurseries.

The selection of nurseries, including tree nurseries, is often influenced by tender conditions. However, even where the decision is made independently, we often find that the source of trees for planting and replacement is a nursery located quite far from the settlement in question. According to the interviews, the main reason for this is that there are no nurseries in the local area capable of providing the required quality and quantity. In local authorities, the task of visiting nurseries, as well as coordination and liaison, often does not fall within the remit of a horticultural specialist; in other words, the clerk or the local authority's grant officer is frequently left to deal with this matter on their

own. In the contracts concluded with nurseries , individual local authorities follow very different practices, which has significant consequences in terms of safeguarding the local authority's interests.

Maintaining a municipal tree nursery does not necessarily seem justified to local authorities. In most cases, it is possible to propagate saplings for future replanting at existing nurseries or on sites also used for horticultural purposes, a practice already adopted by some local authorities. In these localities, when planting a row of trees, 20–50% of the trees ordered from nurseries are potted on at the local nursery for future replacement. A major advantage of this method is that the tree-lined avenues do not become patchy when individual trees are lost, as replacements are provided with specimens of the same age. Furthermore, sourcing certain nursery varieties may become more difficult and costly over time.

Watering

According to stakeholders' reports, except for settlements of particular importance to tourism, it is uncommon in the region to have a developed irrigation system that provides daily watering within built-up areas. In most places, watering the trees daily remains a problem even during the summer months. In these settlements, the local authority officials responsible for the trees themselves believe that the current tree population is unsustainable, even in the short term, given the ongoing drought.

Where irrigation systems exist, they are often damaged due to public use of the space.

Attempts have been made in many places to involve the public in watering – these have typically failed due to a lack of proper education and commitment: "We planted 24 trees as part of the national afforestation programme. The small-leaved trees [i.e. lime trees] died out – five of them – because the public did not water them. The local community does not feel that [the trees] belong to them."

Management

Tree management is carried out according to different principles and practices across local authorities. These principles and practices are determined by the nature of the existing green infrastructure and local traditions, as well as by

the individual experiences, ideas and values of those responsible for the trees, and not least by perceived or actual opportunities in terms of both development and expertise, as well as financial resources.

Trees are often first addressed in response to public reports, due to a tree becoming hazardous or involving overhead cables. In most towns, the assessment of old and/or diseased trees in built-up areas is carried out once or twice a year, or every one or two years, with the involvement of an external specialist ('tree doctor'). Often, the assessment and inspection of trees are carried out by the town clerk, deputy clerk, or public space supervisor rather than by an expert. Where the town has a competent person, such as a head gardener or a gardener, the survey forms part of their remit and is typically carried out twice a year (in spring and autumn). In these cases, operational tasks and management are carried out in accordance with the gardener's recommendations and instructions. In most cases, the clerk designates all tasks relating to the trees, including those concerning their management.

The involvement of external specialists in surveys and in determining or even carrying out treatments takes place based on a network of contacts and established patterns, fixed practices – in short, following established custom.

Civil society

A significant proportion of the actors believe that cooperation with local civil society groups and organisations is generally beneficial for the trees, the local population and the local authority alike. In some settlements, it also happens that local civil society groups take on responsibilities that elsewhere would fall under the remit of the local authority.

Experience to date confirms that civil initiatives mostly become part of local public life through the involvement of the more highly qualified, middle-class members of the local community. With such initiatives, there is a legitimate concern that they may in fact represent the interests of a narrow group–the local middle class and intellectual elite–a concern often recognised by local government officials and informants themselves.

Local identity, tourism and land use

Plantings that are significant in terms of the townscape, the 'landscape varieties', and trees that are often old and of not only natural but also (local)

historical (see Nagy-Laczkó 2022a; 2022b) and cultural significance, play a prominent role in the self-representation of the settlement, the preservation, maintenance and transmission of local identity, and in many cases in tourism as well (Nagy-Laczkó, 2025a; 2025b). The latter is a significant economic factor that local authorities also consider. The growing popularity of ecotourism in the region further enhances the value of these trees. In this context, Katalin Juhász (2014) also draws attention in her study to the potential for social utilisation of research specifically targeting county groves.

In all the settlements examined, the planting of tree-lined avenues and individual trees in public spaces is subject to local authority regulation, though the extent of this varies. The regulations follow similar principles to those for native species, which I discussed above. By stipulating, in the vast majority of the settlements examined, which species are to be planted in public spaces and what level of protection specific trees enjoy, the local authority simultaneously determines the role these trees play in cultural representation and collective memory. In this respect, trees behave like monuments and can be regarded as defining elements of the spatial landscape; consequently, examining them in this light is highly appropriate (cf. Assmann, 1999, pp. 38–39, 51–55, 70–73; Barna, 2002, p. 160). The rationale for their protection lies mostly in the role they play in local identity rather than in their natural value; local protection is often granted to specimens of species that were not endangered at the time of nomination. In many cases, these are named trees (Erkel Tree, Cimbora Tree, Bandika Tree, Tüzefa, Makkfa and so on). A similar practice can be observed during the process of inclusion in the register: protected trees and tree-lined avenues appear in the categories of natural, cultural or historical values. Moreover, these trees, which preserve cultural identity and serve as memorials, are often fitted with commemorative and information plaques, thereby becoming key points and prominent features of tourist routes designated by local authorities – mostly through investments and projects (Nagy-Laczkó, 2025a). All this can be illustrated with case studies.

The ‘grove’ preserving the memory of Liget

In Mezőkovácsháza, following the construction projects of the socialist era, the devastating windstorms of the 1970s, and natural ageing, the Heroes’ Grove can now largely be found in the suspended corridor of the local library. Of the

159 trees, mostly ash trees, planted in 1929 in old Mezőkovácsháza in memory of the heroes who fell in the First World War, barely fifteen remain today, and even of these, one or two perish every summer. Not even this many remain of the heroic trees of Reformátuskovácsháza, once an independent town and now part of Mezőkovácsháza. After planting, these trees were marked with small plaques commemorating the fallen heroes; these can now be seen in the town library's gallery, preserving the memory of the grove that was once intended as a memorial.

A new life for a dead tree

In the centre of Gyula, the Wenckheim family–who owned significant estates in Békés County during the 18th and 19th centuries–created their English garden using the natural stand of trees in the grove surrounding the Fehér-Körös. Today, the memory of this garden is preserved primarily by a single English oak in the Csigakert, the Várkert, and the Várfürdő parks, each of which features one. In the town, there is a conscious effort to preserve these trees even as they decay. A unique example of this practice is the Nimfa statue located at the entrance to the Várfürdő. The sculpture at the entrance to the baths was carved on-site from a dead, centuries-old English oak in 2007, meaning the pedestal of the wooden sculpture is formed by its own root system. Although the carving of the statue was a solo endeavour, several members of the local community have been involved in its upkeep and occasional renovation – most recently in 2021. The artist emphasised that the sculpture refers to the soul of trees; during the carving process, he considered it important to preserve the traces of pests and human damage the tree had suffered over its lifetime. Civil society groups in Szarvas are also striving to implement a similar solution for one of the town's iconic oak trees, which died a few years ago.

Tree families

The people of Dévaványa believe that their Great Acorn Tree, which was also entered into the Tree of the Year competition in 2011, was planted in the 1890s. The Acorn Tree gained national fame as a result of the competition and the associated press coverage. A few years ago, Dévaványa still had its own oak siblings of a similar age, whilst today its own acorn offspring still stand in a row nearby. Since 2016, local schoolchildren and their teachers have set out

every year to collect the fallen acorns of the old tree, so that they can plant them together, nurture them, and then transplant them next to their elderly parents. Year after year, the children return to the young trees and keep track of which one belongs to whom.

In 2017, the three Mezőberény English oaks also 'entered' the Tree of the Year competition, one of which the locals knew as the Petőfi tree (not to be confused with the Petőfi walnut tree, also in Mezőberény). The Petőfi tree, which also enjoyed local protected status, was felled during renovation work on the railway station; its stump is still visible today. Local schoolchildren planted the small Petőfi trees around this stump, which, according to my informant's account, were grown from the tree's acorns.

A similar custom can be observed in connection with the three-hundred-year-old 'Old Lady' of Bélmegyer, a white willow tree known as the oldest in Békés County. The locals believe that as long as the 'Old Lady' stands guard, trouble will spare the village. But her watch is slowly coming to an end, so every year the people of Bélmegyer save live shoots from the withering ancient tree so that it may live on in its offspring.

A common feature of the practices listed as examples is that, in every case, different groups and individuals – using different means – attempt to preserve and pass on the memories associated with the tree and the cultural role it plays in community life, as well as to prevent its destruction. In each case, representatives of the local intellectual, economic and political elite play a decisive role.

Summary: trees and anthropology

Based on my experiences outlined above, I believe that economic, anthropological and tourism-anthropological studies viewing trees as part of ecosystem services would, in the future, provide an opportunity to understand the roles of trees (in settlements), and that local residents could also utilise the knowledge gained through such research. However, in Hungary, tourism-related studies involving trees remain primarily the domain of natural scientists and, increasingly, specialists in marketing geography (Michalkó, 2005; Kulcsár, 2020; Kovács et al., 2021; Köbli & Horváth, 2021). Yet, as Bertalan Pusztai puts it: 'A tourist attraction is always a cultural construct. Without a meaning accepted at the community level, nothing becomes a

tourist attraction. Becoming an attraction is the result of a creative and interpretative process, which is built on the culture that provides meaning; for this very reason, it is group-dependent and relative." (2010, p. 4.)

Economic studies focusing on trees, both foreign and international, can serve as a good starting point for research of an economic-anthropological nature (Becker & Freeman, 2009). Nor can foreign and domestic green infrastructure surveys be separated from socio-economic considerations. There are also examples of domestic studies on these multifunctional resources, integrated ecosystem goods and services that are closely linked to our research topic (Iváncsics & Filepné, 2009). Studies of ecosystem services in the landscapes of the Great Plain can also be partly classified here (OpenNESS, 2014; Kelemen, 2016; OpenNESS, 2016). Nevertheless, domestic studies on community resilience highlight the potential to incorporate trees more precisely by focusing on local attachment (Ispán, 2023).

I trust that my paper has succeeded in highlighting that tree research can indeed play a role in studies of local identity cohesion, so that in future ecosystem research, trees no longer appear solely as fuel, building or furniture timber (or materials). Similarly, when examining residents' quality of life, we could give a greater role to natural features (Lőrincz et al., 2020).

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Edit Hajnal

THE FABRIC OF SUSTAINABILITY – PEOPLE, COMMUNITIES, CONNECTIONS

Abstract

The social dimension of sustainability can be captured in the quality, density and resilience of community relationships. Of the environmental, economic and social pillars, the social component is often pushed into the background, even though relationship structures based on trust, reciprocity and cooperation are fundamental to long-term viability. The 'fabric' metaphor captures this dynamic pattern: the connections between people, communities and institutions are not static elements, but relationships that determine the system's stability and adaptability.

According to the social capital approach, networks of relationships function as collective resources that create a sense of security, identity and collective agency. Strong ties support cohesion and emotional stability, whilst weak ties are crucial for the flow of knowledge, innovation and external connections. The resilience of the social fabric can be understood through the concept of resilience, which indicates communities' capacity to learn, renew themselves and adapt. Social sustainability is thus inseparable from how communities mobilise their resources, integrate change, and maintain their functionality.

Mental well-being emerges as one of the internal prerequisites of social sustainability, as the quality of social relationships, opportunities for participation, and the interpretability of the future directly impact psychological stability. Twin town partnerships form international networks of relationships which, through shared learning, trust-building and collective knowledge-sharing, can be interpreted as the institutionalised social infrastructure of sustainability. In this context, sustainability appears as a living, learning and adaptive system of relationships.

Keywords: *sustainability, social capital, resilience, mental well-being, community relations*

Introduction

The concept of sustainability in the international literature is linked to the 1987 UN report, Our Common Future, commonly known as the Brundtland Report. In the report of the World Commission on Environment and Development, Commission Chair Gro Harlem Brundtland stated the following: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development [WCED], 1987, p. 43, own translation; Dudok, 2024a).

The definition presupposes three pillars – environmental, economic and social dimensions – yet in practice the social component is often sidelined. Sustainability is usually discussed as a matter of resource management or climate policy, whilst there is less recognition that the quality of social relations is itself a structural prerequisite for long-term viability (Dudok, 2024a, 2024b).

This study aims to interpret the social dimension of sustainability through the metaphor of a ‘fabric’. A fabric is not merely a collection of connections but a dynamic pattern: the quality, density, and resilience of the links between people, communities, and institutions determine the system’s resilience.

Sustainability as a living system

According to systems-based approaches, societies are not static structures, but living systems consisting of self-organising, interdependent elements (Capra, 1996). In this interpretation, stability is not the result of rigid regulation but stems from the quality of relationships.

Wheatley’s (1992) organisational theory takes this idea further, arguing that the creativity and capacity for renewal in living systems stem from communication, the flow of information, and reflexive learning. Sustainability is therefore not merely a question of resource allocation, but a matter of relational quality.

However, this metaphorical framework requires operationalisation. If sustainability is indeed a relational phenomenon, then the question arises: what conceptual tools can be used to capture the quality of relationships? At this point, the theory of social capital becomes relevant.

Social capital and relational structures

According to Putnam (2000), social capital – the system of trust, reciprocity and norms of cooperation – functions as a collective resource. Networks of relationships not only facilitate the flow of information, but also create a sense of security, identity and collective agency. A decline in community participation, a weakening of relationship intensity, or a loosening of norms can lead to a decline in social capital, which, in the longer term, also threatens democratic stability.

Granovetter's (1973) theory further differentiates relationship structures by distinguishing between strong and weak ties. Strong ties provide cohesion and emotional stability, whilst weak ties are the conduits of knowledge flow and innovation. From a sustainability perspective, both types of ties are indispensable; internal stability and external connectivity are equally necessary.

The 'fabric' is therefore not homogeneous, but a structured system of relationships with different functions and intensities.

The resilience of the relational fabric

The concept of resilience is a logical consequence of the relational approach. The question is no longer merely what the structure of the relationships is, but also how the system responds to change.

Community resilience is not merely a capacity for crisis management, but a process of learning and reorganisation. There is no universal model for it, as it is influenced by access to resources, social structures and cultural context alike.

According to Ungar (2008), the essence of resilience lies not merely in the presence of resources, but in their culturally meaningful and accessible use. Communities can be considered resilient if they can articulate their resource needs and if those resources fit within their own system of meaning.

Magis (2010) describes community resilience as a collective capacity whereby community members can activate, renew, and sustain their resources in the face of external challenges. Resilience thus becomes an indicator of social sustainability.

Overall, resilience is an indicator of the social fabric's resilience; it signals whether the system can integrate change without its fundamental structure breaking down.

The mental health dimension of social sustainability

The community-based interpretation of resilience is closely linked to mental well-being. Mental health is not merely an individual state, but a phenomenon embedded in a social context (World Health Organisation [WHO], 2022). Kawachi and Berkman (2001) demonstrated that the quality of social relationships acts as a protective factor for mental well-being.

Trust, opportunities for participation and a sense of meaning in the future contribute to psychological stability. It follows that mental well-being is a fundamental prerequisite for social sustainability.

Twin town partnerships – living networks in the European 'fabric'

International town twinning partnerships create transnational networks of relationships that extend beyond the scope of individual projects. They are activated and strengthened through regular meetings, joint programmes and knowledge-sharing mechanisms. In this sense, town twinning partnerships can be understood as a process of cultural learning, during which participants not only exchange professional practices but also convey norms, values and institutional solutions to one another.

Projects linked to the European Union's thematic years – such as GENSOL, which examines intergenerational cooperation; EFAMNET, which analyses the work–family relationship; LOCPAR, which focuses on local social participation; SEECNET, which aims to showcase social enterprises, and SUSCOMNET, which addresses the theme of sustainable cities and communities – have implemented partnership models that can be interpreted as examples of network learning and collective knowledge-building. These programmes have strengthened the international dimension of social capital by facilitating the exchange of experiences and joint reflection within an institutionalised framework.

In the context of international cooperation, sustainability is not a one-off project objective but rather a networked learning process. Regularly recurring activities, the gradual building of trust and the emergence of shared patterns

of action contribute to relationships becoming a stable yet adaptive infrastructure. Within this interpretative framework, town twinning partnerships appear as institutionalised elements of the relational infrastructure of sustainability (European Commission, n.d.).

Conclusions

The study argues that the social dimension of sustainability can be captured in the quality and functionality of relationships. The 'fabric' metaphor conveys that the stability of community systems is not the result of static structures but rather consists of patterns built on trust, reciprocity, and networked embeddedness.

Social capital refers to relational resources, resilience to their mobilisability, and mental well-being as an internal indicator of a functioning relational infrastructure.

The example of twinning partnerships shows that sustainability is not merely an environmental or economic issue, but a learning, adaptive relational system. For future research, it is warranted further to develop measurement frameworks for social cohesion and community resilience and to examine the long-term effects of network learning.

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Lucián Líviusz Olteanu

CLIMATE ANXIETY AS A PSYCHOLOGICAL RISK AMONG THE YOUNGER GENERATION: THEORETICAL INTERPRETATIONS AND PREVENTIVE APPROACHES

Abstract

Climate anxiety manifests among the younger generation as an emotional and cognitive reaction linked to uncertainties, experiences of loss, and threats to the future arising from climate change. It cannot be considered a mental disorder in itself. However, it can become a psychological risk if it persists, hinders daily functioning, and makes identity formation, future planning or career decisions more difficult. Several theoretical approaches can be applied to interpret this phenomenon: the adaptive signalling function of anxiety, collective psychological threat, internal tension arising from value conflicts, impaired future orientation, and existential uncertainty all contribute to an understanding of climate anxiety. The cognitive, emotional and behavioural components of the phenomenon interact with one another. Catastrophic thoughts about the future, a sense of loss of control, guilt, grief, and helplessness may all arise, whilst, at the behavioural level, avoidance, excessive information consumption, or burnout linked to activism may also be observed. Young people's heightened vulnerability is also linked to developmental and neuropsychological factors, as emotional regulation, identity formation, and future-oriented decision-making are still undergoing intensive development during this stage of life. The digital environment may further exacerbate this vulnerability through the constant presence of negative, emotionally charged content. Prevention and intervention can be implemented at multiple levels. With appropriate support, climate anxiety can be interpreted not only as a risk but also as an opportunity to develop awareness, resilience and prosocial engagement.

Keywords: *climate anxiety, younger generation, resilience, mental health, prevention*

Introduction

In recent decades, climate change has become a significant global problem. Organisations such as the World Health Organisation (WHO) and the American Psychological Association (APA) regard climate change as a psychological risk, particularly for the younger generation (American Psychological Association, 2017; World Health Organisation, 2022). The terms 'climate anxiety' or 'eco-anxiety' are now frequently used in research to describe persistent concerns about the future, security and life prospects (Clayton et al., 2017). Recent studies highlight the significance of this issue: according to a 2021 Lancet-Lancaster study, around 60% of young people are very concerned about climate change, and 45% say it affects their daily lives, underscoring the urgent need to address Generation Z's concerns.

Climate anxiety in itself is not a mental disorder. Rather, it is an adaptive emotional response to perceived threats. It becomes a psychological problem when these feelings persist over a long period, interfere with daily life, and make it difficult to carry out important developmental tasks, such as forming an identity or planning for the future.

Generations Z and Alpha face particular challenges. They are growing up surrounded by digital media that regularly highlight the dangers of climate change. As digital services tend to promote negative and emotional content, this can heighten anxiety and feelings of helplessness (Odgers & Jensen, 2020; Twenge, 2017). At the same time, many young people are actively reshaping the narrative by engaging in solutions that counteract this sense of helplessness. For example, youth-led initiatives, such as community solar cooperatives, have emerged as constructive responses to climate issues. These projects empower younger generations to take control of their energy future, thereby fostering both individual agency and community resilience.

This study aims to examine climate anxiety as a complex psychological problem by combining classical and modern theories. It seeks answers to fundamental research questions such as: What makes climate anxiety developmentally unique for today's young people, and which interventions most effectively strengthen resilience? It describes the main psychological aspects of climate anxiety, explains why younger generations are more vulnerable, and makes recommendations for preventing and managing the

problem at individual, family and community levels. The study also examines how climate anxiety may influence decisions regarding the future and career choices.

Conceptual models of anxiety and the interpretation of climate anxiety

Freud's theory of anxiety: signal anxiety and adaptive function

In Sigmund Freud's theory, anxiety does not appear as an independent symptom, but can be interpreted as a signalling function mediated by the ego. Signalling anxiety alerts the individual to internal or external threats to psychological equilibrium and encourages adaptation (Freud, 1926/1996). Based on this approach, climate anxiety can be interpreted as an adaptive emotional response to the realisation of global environmental threats.

Climate anxiety is, however, unique because the threat is long-lasting, difficult to pinpoint, and appears to be beyond the individual's control. This can undermine the helpful aspect of anxiety and prolong the feeling. If this happens, anxiety may lose its motivational effect and instead limit psychological functioning, particularly in young people.

To address this, young people can develop specific coping strategies when they recognise the 'ego-based alarms' of climate anxiety. A practical tool could be an 'anxiety-response chart', which links these alarms to specific coping activities. For example, keeping a diary can help in expressing thoughts and feelings, whilst social engagement can reduce feelings of isolation. Practising mindfulness can also help in managing overwhelming emotions, enabling a transition from anxiety to constructive action.

Jung: collective anxiety and archetypal collapse

Carl Gustav Jung's analytical psychology allows us to interpret climate anxiety not only as an individual but also as a collective psychological phenomenon. According to Jung, certain historical and social crises activate the archetypal content of the collective unconscious, triggering widespread emotional reactions (Jung, 1964/2011). The climate crisis can be interpreted as a global crisis that mobilises the archetypes of collapse, destruction and finitude. At the same time, it is important to highlight the role of collective healing practices in transforming this narrative. Community rituals and storytelling

methods, such as climate cafés and eco-mourning circles, provide a space for shared interpretation. These occasions help to transform shared anxiety into solidarity, fostering a sense of community and hope.

Through participation in these practices, individuals can collectively process their fears, which fosters self-confidence and strength. From this perspective, climate anxiety is not simply a personal fear, but also reflects a shared psychological experience. Stories about an uncertain future and discussions of 'irreversible processes' can evoke emotions in young people that are difficult to cope with on their own. This is particularly important during adolescence and young adulthood, when identity is still forming, and the influence of the group is strong.

Rogers: inconsistency, conflict of values and moral tension

In Carl Rogers' humanistic theory, the fundamental source of psychological distress is inconsistency, that is, the tension between an individual's inner experiences and their self-image (Rogers, 1959). Within this framework, climate anxiety can be understood as an experience arising from the gap between an individual's moral values and the realities of everyday life. To reduce this Rogersian inconsistency, young people can engage in exercises to clarify their values, such as assessing their personal carbon footprint or keeping an ethical diary. Assessing personal carbon emissions encourages individuals to evaluate their daily activities in terms of their carbon footprint, whilst ethical journaling allows them to reflect on their personal behaviour and align it with their moral commitments, thereby fostering a more consistent self-image.

Discussions about sustainability, responsibility and global justice often set high standards that people cannot always meet. This can cause internal conflicts, which can lead to feelings of guilt, helplessness and anxiety. According to Rogers' theory, climate anxiety is particularly difficult when people feel that their lives are at odds with their own values.

Zimbardo: time perspective, loss of control and future-oriented anxiety

According to Philip Zimbardo's time perspective theory, individuals' psychological functioning is significantly determined by how they relate to the past, the present and the future (Zimbardo & Boyd, 2008).

Climate anxiety is often associated with a negative bias towards the future, in which the future is primarily viewed as a threat and a source of loss. This outlook on the future can be particularly difficult for young people, who need to make important plans and career decisions. If the future seems unpredictable or unlivable, it can reduce motivation, create a sense of helplessness, and make decision-making even more difficult.

Peterson: an existential interpretative framework

In Jordan B. Peterson's work, crises often appear as existential liminal situations in which the individual is confronted with the tension between order and chaos (Peterson, 1999). Based on this approach, climate anxiety can be interpreted as a psychological state in which the scale and complexity of the problem exceed the individual's interpretative and action frameworks.

This perspective helps us to view climate anxiety not merely as a scientific model, but as a means of gaining a deeper understanding of the problem. The climate crisis may seem so overwhelming that it can paralyse people unless they find a way to make sense of it and take small, manageable steps.

The psychological components of climate anxiety

Climate anxiety can be understood as a complex, multidimensional psychological phenomenon, best understood through the active interaction of cognitive, emotional and behavioural components. It is helpful to view these dimensions as interconnected, where cognitive processes influence emotions, emotions affect behaviour, and behavioural responses feed back into cognitive patterns. The literature increasingly argues that these components do not operate in isolation from one another, but rather contribute to the persistence and intensification of anxiety as mutually reinforcing processes (Clayton et al., 2017; Pihkala, 2020).

One characteristic of climate anxiety is that its object is not a specific danger clearly defined in time and space, but a global, long-term threat that far exceeds the individual's capacity for control and requires particularly demanding cognitive and emotional processing.

Cognitive components

Concerns about the future form a significant part of the cognitive aspect of climate anxiety. People may experience extreme thoughts such as 'there will

be no future', 'there is no point in planning' or 'everything will collapse anyway'. These ways of thinking can make planning, setting goals or decision-making difficult, particularly for teenagers and young adults (Erikson, 1968).

A common cognitive bias is catastrophising, where people expect the worst and ignore the possibilities for coping (Beck & Haigh, 2014). The media often presents climate change in a dramatic light, which can further exacerbate this mindset, particularly when people are exposed to predominantly negative news.

The experience of a loss of control can also be seen as a central cognitive component. Given the global nature of climate change, individual action often seems ineffective, which can lead to a psychological state akin to learned helplessness (Seligman, 1975). Counterexamples, however, show that even small-scale youth initiatives can have tangible effects. For example, a renewable energy project at a local secondary school reduced carbon dioxide emissions by 30% in one year, resulting in measurable savings in the community's electricity costs. Furthermore, in another town, a youth-led recycling campaign successfully diverted 50% of waste from landfill sites in its first six months. (Yang et al., 2023) These initiatives demonstrate that individual and local actions, though small, can add up to bring about significant change. This lack of control may further exacerbate uncertainty in decision-making and passivity regarding the future, particularly in areas such as life planning and career choice.

Emotional components

The emotional dimension of climate anxiety is varied and is not limited to the classic symptoms of anxiety. It often manifests as heightened psychological distress, constant tension, sadness and a sense of loss. The literature increasingly describes this phenomenon as 'environmental grief' or 'eco-grief', which encompasses grief reactions to environmental destruction, biodiversity loss, and the loss of the future (Pihkala, 2020; Cunsolo & Ellis, 2018).

Guilt is also an important emotional component of climate anxiety, particularly when people feel bad about their own consumption and environmental impact. 'Carbon guilt' means that people feel their decisions contribute to global problems, even if their actual impact is minimal

(Markowitz & Shariff, 2012). This guilt can lead to long-term exhaustion, self-reproach and lower self-esteem.

Emotional reactions to climate anxiety are not all negative. Sometimes anxiety and anger can motivate people to take action or help others, thereby making them feel more in control of their lives and giving their lives greater meaning (Ojala, 2012). However, if activism does not lead to real change, these feelings can also turn into hopelessness and burnout. To help readers distinguish between healthy commitment and activist burnout, it is worth considering the following checklist:

- Persistent lack of sleep or fatigue
- Diminished enjoyment of previously satisfying activities
- Feeling overwhelmed or constantly anxious
- Detachment or cynicism regarding activist activities
- A decline in social interactions or community involvement

Recognising these signs can help individuals take steps to recover before it leads to burnout.

Behavioural components

Climate anxiety can manifest in a variety of behaviours, often as a result of thoughts and feelings.

A common reaction is avoidance, in which people steer clear of news or conversations about climate change. Whilst this may help in the short term, over time it can limit people's ability to process information and make it harder to address the problem (Hayes et al., 2016).

The other extreme is over-engagement, in which an individual resorts to intense activism or constant information seeking. In this case, activism can function as a coping strategy, but there is a risk of burnout and emotional overload, particularly if the individual lacks adequate emotional regulation skills.

Excessive digital monitoring, commonly known as doomscrolling, is a characteristic behavioural manifestation of climate anxiety. This phenomenon refers to the compulsive consumption of negative news and threatening content, which is further reinforced by online platforms' algorithms (Odgers

& Jensen, 2020). Doomscrolling increases anxiety, reinforces catastrophic thinking and reduces the possibility of emotional recovery.

The heightened vulnerability of the younger generation

The effects of climate anxiety are not evenly distributed across different age groups. According to both the literature and developmental psychological approaches, adolescence and young adulthood are particularly vulnerable periods for the psychological processing of global crises. This vulnerability stems from the complex interplay of neuropsychological, developmental, social, and digital factors.

Neuropsychological characteristics and emotion regulation

From a neuropsychological perspective, a defining characteristic of adolescence and young adulthood is that the prefrontal cortex, which is responsible for emotion regulation, impulse control and long-term planning, does not fully develop until the mid-20s (Casey et al., 2008; Steinberg, 2010). At the same time, the limbic system, which plays a key role in the intensity of emotional responses, matures earlier, leading to heightened emotional reactivity.

This neurological asynchrony makes young people p Due to this difference in brain development, young people may be more sensitive to news about climate change. Coping with long-term, abstract threats requires mental and emotional capacities that are still developing at this age. As a result, climate anxiety may seem more intense and harder to manage. This, combined with future orientation.

From a developmental psychology perspective, adolescence and young adulthood are critical periods for identity formation and future orientation. According to Erikson's (1968) theory, the fundamental developmental task for the individual during this stage of life is to establish identity amid a multitude of roles. Ideas, goals and plans for the future play a central role in this process.

Climate anxiety can make the future seem uncertain, frightening or difficult to understand. This can make it difficult for young people to develop a stable sense of self in a world that seems unpredictable. Questions such as 'Why should we plan?' or 'Is there any point in thinking long-term?' are not merely doubts, but genuine obstacles to development.

The impact of the social and digital environment

The workings of digital and social media further exacerbate young people's vulnerability. Social media and news sites often present dramatic, emotionally charged stories about climate change (Odgers & Jensen, 2020). Algorithms tend to highlight negative information, which can keep anxiety levels high.

The normative influence of peer groups, influencers and activist discourse is also significant. In certain communities, constant worry and emotional engagement can become an implicit norm, making it difficult to process emotions in a balanced way. In this sense, climate anxiety can be understood not only as an individual experience but also as a psychological state shaped by social reinforcement.

Climate anxiety, future planning and career uncertainty

A less-researched but extremely important consequence of climate anxiety is the increased difficulty in decision-making when planning for the future and choosing a career. One of the central tasks of adolescence and young adulthood is career choice and life planning, which inherently involves heightened psychological stress. If the future appears uncertain or threatening on a global scale, this can further complicate decision-making.

Conceptual models developed for the psychological examination of decision-making difficulties, such as the Career Decision-Making Difficulties Questionnaire (CDDQ) model, provide a relevant interpretative framework for understanding this phenomenon (Gati et al., 1996). The CDDQ identifies decision-making difficulties in three main areas: a lack of readiness to make decisions, insufficient or contradictory information, and internal conflicts.

In theory, climate anxiety may have a reinforcing effect across all three areas. The perception of a future threat may reduce motivation to make decisions, increase information overload, and generate internal conflicts between ‘safe’ and ‘morally correct’ career paths. The results of the Hungarian adaptation of the CDDQ also confirm that uncertainty about the future and difficulties in decision-making are closely linked to indicators of psychological well-being (Olteanu, 2022). To illustrate this, let us consider a secondary school student named Emily, who is passionate about environmental science but is concerned about the profession's stability in light of climate change. During a climate-conscious counselling session using the CDDQ, Emily was able to recognise

her concerns about her career choice, particularly regarding job security and moral alignment. Through structured exercises, the session helped her explore different career paths, such as sustainable engineering or environmental policy-making, which align with her values and interests. This clarity boosts her confidence in decision-making by resolving conflicts between her goals and perceived risks.

Prevention and intervention options

When managing climate anxiety, the focus should be on prevention, as it often manifests as a normal emotional response that can become problematic in difficult situations (Dudok, 2025). The aim is not to eliminate anxiety, but to help people manage it and to develop skills for managing anxiety in individuals and communities (Clayton et al., 2017; Pihkala, 2020).

Individual-level approaches

At the individual level, helping people process their thoughts and feelings can be effective in managing climate anxiety. Cognitive- e behaviour therapy (CBT) is particularly useful in changing catastrophic thinking, extreme views about the future, and feelings of loss of control (Beck & Haigh, 2014). To make CBT more relevant to the treatment of climate anxiety, CBT worksheets can be adapted to address eco-catastrophism. For example, a 'pros and cons' table can be used for the statement 'There is no future'. This table helps individuals critically examine the evidence supporting their fears about climate change, whilst also recognising the counter-evidence. Through this process, CBT can help people to see climate change not simply as a threat, but also as an area where they have the opportunity to take meaningful action.

Techniques for managing emotions, such as mindfulness and grounding exercises, can also help reduce climate anxiety. These methods encourage people to accept and acknowledge their feelings, rather than avoiding the problem or becoming overly immersed in it (Hayes et al., 2016).

Ojala's (2012) approach of 'sustainable hope' is also important. This does not mean ignoring problems or being unrealistically positive. Instead, it helps people accept negative feelings whilst finding realistic, action-oriented solutions to address the problems. Sustainable hope is a key component of resilience and can reduce feelings of helplessness and hopelessness.

Family-level interventions

The family plays a major role in how children and teenagers cope with climate anxiety. Parents' emotional regulation, communication and problem-solving methods teach young people to understand and manage global crises (Morris et al., 2007).

Open and non-judgmental communication allows young people to share their fears and doubts without feeling rejected or overwhelmed. It is also important to avoid using narratives that exacerbate anxiety, as this can intensify feelings of a loss of control. Families can help by providing stability and channelling climate anxiety towards healthy coping strategies.

School and community-level approaches

School- and community-level interventions play a key role in preventing climate anxiety, as these settings foster collective coping and self-advocacy. Schools and communities are important in preventing climate anxiety because they support collective coping and self-advocacy. Organised discussions help young people process information about climate change step by step, which can prevent overwhelm and extreme reactions. One example of this is Greenfield Secondary School, which achieved zero-waste status through collaboration among pupils, teachers and local businesses. This initiative not only reduced the school's environmental impact but also engaged pupils in meaningful activities, demonstrating that collective action can transform anxiety into tangible hope. (The Greenfield Secondary School Sustainability Club has set itself the goal of educating students about nature conservation and climate issues by 2025.) Programmes teaching digital awareness, such as recognising and managing doomscrolling, can also reduce anxiety stemming from the media (Odgers & Jensen, 2020). Together, these efforts can increase resilience and encourage people to help others.

Discussion and conclusions

Climate anxiety is not in itself a mental health problem, but rather a normal emotional reaction to real global threats. It becomes a risk when these feelings persist for too long, become uncontrollable, and restrict a person's thoughts, feelings, or actions.

For young people, climate anxiety arises at a time when they are forming their identities, thinking about their future and making career choices. It is particularly important to develop resilience and provide mental health education, as these can reduce feelings of helplessness and encourage young people to take action. At the levels of school, family, and community, efforts can be made to ensure that climate anxiety becomes an experience that fosters development rather than hinders it. With appropriate support, this phenomenon need not merely represent a psychological burden, but can also present an opportunity for development, fostering the emergence of a more conscious, resilient and prosocial generation.

Future research directions: Further research is needed to gain a deeper understanding of climate anxiety and its effects on young people. Longitudinal studies tracking individuals over time can provide valuable insights into how climate anxiety develops and how it influences psychological well-being and life decisions. Furthermore, cross-cultural research would enrich the field by examining how cultural contexts shape the perception and management of climate anxiety worldwide. By identifying these research priorities, we hope to stimulate scientific research and broaden the range of strategies available for the effective management of climate anxiety.

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GAMIFIED PEDAGOGICAL MODELS IN SUSTAINABILITY EDUCATION

Abstract

One of the fundamental challenges of education for sustainability is that global environmental issues often seem abstract, distant and difficult for pupils to relate to personally. Gamified pedagogical approaches can bridge this gap by transforming the learning process into an engaging, participatory environment that offers opportunities for decision-making. The use of game design elements does not mean turning learning into a game, but rather the incorporation of motivational, structural and feedback mechanisms that support engagement, agency and long-term commitment. The pedagogical effectiveness of gamification lies in strengthening the experience of autonomy, competence and connection. These factors are particularly important in education for sustainability, where the aim is not merely the transfer of knowledge, but the shaping of attitudes, emotional engagement and the development of action competence. In the climate education approach, the teacher's role shifts towards that of a facilitator and mediator: they organise learning situations in which pupils can reflect on the social, ethical and emotional dimensions of climate change, whilst also experiencing the consequences of their own decisions and collective actions. Of the gamified pedagogical models presented, the narrative-based approach builds on roles, decisions and meaning-making embedded within a story, whilst the experience-based model emphasises gaining experience, problem-solving and reflection. The integrated model combines these two approaches and interprets sustainability education within an interrelated system of cognitive, emotional, behavioural and community dimensions. In this context, gamification emerges as a pedagogical framework that facilitates the personal, communal and practical engagement with sustainability issues.

Keywords: gamification; education for sustainability; climate education; experiential learning; narrative learning

Introduction

The issue of sustainability has become one of the defining challenges of education in the 21st century. Although the topic features increasingly prominently in curricula and pedagogical discourse, the learning process often remains at a theoretical level: sustainability is presented as a global, abstract problem that learners find difficult to relate to personally. As a result, the knowledge acquired often fails to translate into action-oriented thinking or everyday practice.

Education for sustainability presents specific challenges from a pedagogical perspective. Complex, multidimensional problems do not fit easily into traditional, subject-centred educational models, whilst students' emotional responses – including climate anxiety and uncertainty about the future – are becoming increasingly prominent (Ojala, 2012; Hickman et al., 2021). In this context, learning cannot be limited to the transfer of knowledge; it requires pedagogical approaches that foster emotional engagement, motivation, and agency simultaneously.

In response to these challenges, increasing attention is being paid to forms of learning organisation that are experience-based, participatory, and provide opportunities for the active involvement of learners. Gamification – the application of game design elements in a non-gaming context – can be seen as a particularly promising approach in this regard (Deterding et al., 2011). Gamified structures can create a learning environment in which learners participate in decision-making, receive feedback, and interpret their experiences within a community context.

This study examines the possibilities for integrating gamification and education for sustainability. The theoretical framework discusses the psychological foundations of gamification, the characteristics of education for sustainability, and the dimensions of climate education, before presenting three gamified pedagogical models that synthesise these. The approaches presented highlight that gamification is not merely a motivational tool, but a complex pedagogical framework capable of integrating the cognitive, emotional and social dimensions of learning.

The Pedagogical and Psychological Foundations of Gamification

Over the past decade, gamification has become a key area of innovation in education, based on the application of game design elements in non-gaming contexts (Deterding et al., 2011). The essence of the approach is not to 'turn the learning process into a game', but to adapt the motivational, structural and feedback mechanisms familiar from games to learning environments that are not inherently game-like. Gamification can thus be understood as a pedagogical tool capable of increasing learner engagement, active participation and long-term commitment.

One of the keys to gamification's effectiveness lies in its psychological foundations. According to self-determination theory (SDT), human motivation is based on the fulfilment of three fundamental psychological needs: autonomy, competence, and relatedness (Deci & Ryan, 2009). Autonomy means that the individual can make their own decisions; competence refers to the experience of growth and effectiveness; whilst relatedness refers to the experience of belonging to a community. A well-designed gamified learning environment supports all three dimensions: it provides opportunities for choice, makes progress visible, and offers a sense of community.

From the perspective of motivational processes, it is particularly important to distinguish between intrinsic and extrinsic motivation. Whilst extrinsic motivation is linked to rewards or recognition, intrinsic motivation stems from performing the activity for its own sake (Ryan & Deci, 2000). Gamification can be considered pedagogically effective if it not only employs external reward systems (e.g., points, badges) but also makes the learning activity meaningful and experiential, thereby fostering the development of intrinsic motivation.

One of the central concepts of the gaming experience is 'flow', as described by Mihály Csíkszentmihályi (1990). The state of flow is an optimal psychological state in which the individual is fully immersed in an activity, whilst the level of challenge and the available abilities are in balance. One of the key aims of gamified learning environments is to create this state, which enhances concentration, enjoyment and the effectiveness of learning.

Theories of behavioural change also contribute to our understanding of how gamification works. The learning process is often described as a cyclical structure comprising trigger–action–reward–investment elements (Eyal, 2014). Gamification consciously applies this cycle: immediate feedback, the visual representation of progress, and goals broken down into small steps all contribute to making the learning activity a habit. This is particularly important in the context of education for sustainability, where the goal is not one-off knowledge acquisition but long-term behavioural change.

From a pedagogical perspective, a further advantage of gamification is its ability to create a safe learning environment in which mistakes do not lead to negative consequences but are seen as a natural part of the learning process. This reduces performance anxiety and allows for experimentation, which is particularly important when addressing complex issues – such as sustainability. Furthermore, gamification promotes differentiated learning by offering multiple entry points for learners, making it effective even in heterogeneous groups (Kapp, 2012).

The Challenges and Pedagogical Framework of Education for Sustainability

Education for Sustainable Development (ESD) has become a central focus of international educational policy and pedagogical discourse in recent decades. The concept is based on the notion of sustainability developed in the wake of the Brundtland Report, which envisages meeting the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment and Development – WCED, 1987). The role of education in this process is crucial, as sustainability is not merely a matter of knowledge but also involves shaping values, attitudes, and behavioural patterns (UNESCO, 2017).

One of the fundamental characteristics of education for sustainability lies in its complexity. Sustainability issues (such as climate change, biodiversity loss or social inequalities) are part of complex, interrelated systems that cannot be understood within the framework of a single discipline (Sterling, 2001). Real-world examples of adaptive socio-economic systems, such as the historical development of the Channel Islands, illustrate how complex, interrelated environmental, economic and social factors shape sustainability processes,

thereby reinforcing the importance of systems thinking in education for sustainable development (Zádori, 2020). This complexity creates pedagogical challenges, as traditional, subject-centred, and linear knowledge transfer is unable to adequately address such problems. Consequently, ESD requires an interdisciplinary approach that integrates perspectives from the natural sciences, social sciences and ethics (Tilbury, 2011).

Another key dimension of education for sustainability is its value-based nature. The learning process involves not only the transfer of information but also the communication of norms and values that shape relationships among individuals, communities, and their environment (Wals, 2015). This is a particularly sensitive area of education, as issues of sustainability often raise moral dilemmas and do not offer clear, universal answers. In this context, the teacher's role is not to convey 'correct answers', but to create a learning environment that supports critical thinking and reflective interpretation (Jickling & Wals, 2008).

The literature increasingly emphasises that education for sustainability cannot be purely cognitive. The emotional engagement of learners plays a key role in making sustainability issues personal and action-oriented (Ojala, 2012). Research on climate change indicates that climate anxiety is increasingly common among young people and can negatively affect their sense of agency (Hickman et al., 2021). At the same time, the appropriate pedagogical management of emotions (such as emphasising hope and agency) can contribute to the development of positive attitudes and proactive behaviour (Ojala, 2015). Accordingly, education for sustainability must integrate cognitive, emotional and action-oriented dimensions.

Action-orientation is a defining feature of ESD. The aim is not merely to increase knowledge, but to promote pupils' active participation and sense of responsibility (Mogensen & Schnack, 2010). This approach is closely linked to competence-based education, which emphasises the development of problem-solving, collaboration and critical thinking. Within the framework of education for sustainability, the development of so-called 'action competence' is particularly important, as it enables students to actively participate in shaping a more sustainable future (Jensen & Schnack, 2006).

From a pedagogical perspective, all this requires a rethinking of the learning environment. Instead of traditional, teacher-centred methods, active, participatory forms of learning are playing an increasingly important role, including project-based, problem-based, and experiential learning (Kolb, 1984; Thomas, 2000). These approaches enable learners to work on real-world problems and develop a deeper understanding through their own experiences. The learning process thus becomes not linear but cyclical and reflective, in which experience, interpretation, and application reinforce one another.

The social dimension of education for sustainability is also worth highlighting. Learning is not an isolated individual process, but a communal activity in which meanings are constructed collectively (Vygotsky, 1978). In this sense, schools can be regarded as 'micro-societies' where the practical implementation of sustainability can also be modelled (Wenger, 1998). Collaborative learning fosters cooperation, empathy and social responsibility, all of which are fundamental elements of sustainable thinking.

Climate Education and the Role of the Teacher in Sustainability Learning Processes

Climate education is a specific yet increasingly significant area of sustainability education, focusing on the pedagogical treatment of the complex phenomenon of climate change. Climate change is not merely a scientific problem, but a complex phenomenon with social, economic and ethical dimensions that fundamentally reshape our thinking about the future (Legg, 2021). Consequently, climate education cannot be limited to the transfer of knowledge, but requires an integrated approach that supports pupils' cognitive, emotional and social development alike.

The role of the teacher in this process is undergoing a significant transformation. Instead of the traditional role of knowledge transmitter, the functions of facilitator and mediator are increasingly coming to the fore, in which the teacher acts as the organiser of the learning process, the guide of dialogue and the supporter of meaning-making (Freire, 1970). According to the critical pedagogy approach, knowledge is not neutral but forms the basis of social agency; it is therefore the teacher's task to create a learning

environment in which learners can be active interpreters and shapers of global processes.

One of the key concepts of climate education is intergenerational dialogue, which stems from the recognition that the timescale of climate change extends beyond the lifetimes of individual generations (UNESCO, 2017). Younger generations often respond to the future with strong emotional reactions – such as anxiety or uncertainty – whilst the experiential knowledge of older generations can act as a stabilising factor (Hickman et al., 2021). In this context, the teacher plays a mediating role, facilitating the encounter and integration of different experiential horizons. This dialogue not only expands knowledge but also strengthens social cohesion (Wals, 2015).

Another key dimension of climate education is the development of emotional resilience. Climate anxiety is an increasingly well-documented phenomenon, particularly among young people, which can influence learning processes and attitudes towards the future (Ojala, 2012; Hickman et al., 2021). In educational practice, it is therefore of paramount importance that pupils are not merely confronted with the gravity of the problems, but are also provided with interpretative frameworks that support the development of hope and agency (Ojala, 2015). In this sense, resilience does not mean suppressing negative emotions, but rather processing and integrating them constructively.

Climate education is closely linked to the concept of student agency, which aims to develop students' capacity for action and self-efficacy (Dudok, 2025). According to Bandura's (1997) social-cognitive theory, self-efficacy is a fundamental factor in whether individuals feel capable of shaping their environment. The aim of climate education is therefore not to reinforce a sense of helplessness, but to create learning situations in which students can experience concrete opportunities for action (Jensen & Schnack, 2006). This can be achieved particularly well through project- and problem-based learning approaches that address real-world issues (Thomas, 2000).

Reflection also plays a central role in climate education practice. According to Dewey (1938), learning is not merely the acquisition of experience, but the conscious processing and reinterpretation of those experiences. Issues relating to climate change, in particular, call for this reflective approach, as they simultaneously involve scientific knowledge, ethical dilemmas, and social

responsibility (Mezirow, 2000). Reflective pedagogy enables learners to develop nuanced, context-sensitive interpretations and to recognise their own role within complex systems.

The ethical dimension of climate education is also significant. Issues relating to sustainability inevitably raise questions of justice, responsibility and our duty towards future generations (Nussbaum, 2011). The teacher's role in this context is not to convey normative positions, but to facilitate a dialogue in which pupils can explore and weigh up different perspectives. The development of empathy plays a key role in this process, as it enables an understanding of others' situations and fosters a sense of global responsibility.

However, the community dimension of climate education must also be highlighted, as schools are learning communities where patterns of social cooperation form (Wenger, 1998). Community learning promotes collective problem-solving and the development of shared visions, which reduce anxiety arising from uncertainty and strengthen belief in the power of action (Wals, 2015). In this process, the teacher not only supports individual learning pathways but also contributes, at the community level, to strengthening resilience and social cohesion.

The Integration of Gamification and Sustainability in Education

The combination of gamification and sustainability education represents a pedagogical innovation capable of addressing the complex challenges of sustainability education. Whilst the aim of education for sustainability is to foster responsible thinking and action, gamification offers a methodological framework that promotes student engagement, experiential learning and the maintenance of long-term motivation (Deterding et al., 2011; Kapp, 2012). The integration of these two approaches is thus not merely a methodological issue, but signals the emergence of a new pedagogical paradigm.

One of the fundamental challenges of education for sustainability is that students often perceive global environmental issues as distant and abstract (Sterling, 2001). Gamification, by contrast, can transform learning content into concrete, experiential situations in which students serve as active participants. The game-based environment creates opportunities for learners to make decisions, experience their consequences, and reflect on their own actions. This experiential learning is particularly important in the context of

sustainability, where real-world consequences are often only perceptible in the long term (Kolb, 1984).

One of gamification's most significant contributions to sustainability education is the strengthening of emotional engagement. Through narratives, roles and challenges, learners not only understand the issues but also connect with them on a personal level (Hamari et al., 2014). This emotional dimension plays a key role in ensuring that learning does not remain at the cognitive level, but leads to changes in attitude and behaviour. Research shows that the combination of emotional engagement and opportunities for action increases the likelihood of sustainable behaviours developing (Ojala, 2012).

Gamification also supports action-oriented learning, which is a central element of education for sustainability. Game-like structures – such as missions, challenges, and feedback systems – enable learners to build their knowledge and skills in small, gradual steps (Dudok, 2024; Eyal, 2014). This is consistent with the concept of 'action competence', which is fundamental to education for sustainability (Jensen & Schnack, 2006). In gamified environments, learners not only understand the issues but also experience their own effectiveness through concrete actions.

From an inclusivity perspective, gamification is a particularly valuable approach. Game-based learning environments provide a low entry threshold and offer the opportunity for learners with varying abilities, prior knowledge and levels of motivation to engage in the learning process (Gee, 2003). Differentiated tasks, multiple roles and flexible progression paths enable every learner to find their own point of connection. This is particularly important in education for sustainability, where the aim is not uniform knowledge, but shared thinking and collaborative learning.

The social dimension of gamification also plays a significant role in sustainability education. Cooperative game mechanics foster collaboration, communication, and collaborative problem-solving, all of which are fundamental elements of sustainable thinking (Wenger, 1998). Shared goals and challenges strengthen community identity and foster social responsibility. The learning process thus becomes not only an individual but also a collective experience.

It is important to emphasise, however, that gamification cannot be regarded as a solution in itself. The literature indicates that systems based solely on external rewards are unsustainable in the long term and may even lead to a decline in intrinsic motivation (Deci et al., 1999). Therefore, ethical and conscious design is key to the pedagogical application of gamification, as it strengthens learners' autonomy, sense of competence and social connections (Ryan & Deci, 2000).

Gamified Pedagogical Models in Education for Sustainability

The integration of gamification and education for sustainability represents not merely a methodological innovation, but also enables the development of complex pedagogical models capable of fostering the cognitive, emotional and social dimensions of learning in tandem. In what follows, three interrelated yet distinct gamified pedagogical models will be presented: the narrative-based approach, the experience-based model, and an integrated framework that can be interpreted as a synthesis of the two.

Narrative-based gamification: a story-based learning model

Narrative-based learning is one of the oldest and most effective pedagogical tools, playing a decisive role in meaning-making, particularly among younger age groups (Bruner, 1996). Stories enable learners to process complex phenomena in a structured, comprehensible and emotionally engaging form. Combined with gamification, the narrative approach creates a learning environment in which learners are not merely recipients but active shapers of the story.

The central element of the narrative-based gamified model is the story, which serves as a framework linking learning content and game mechanics. Roles, missions and decision-making situations all become part of the narrative, giving the learning process a coherent and meaningful structure. This approach is particularly effective in sustainability education, where abstract concepts – such as responsibility, environmental awareness or cooperation – become comprehensible through concrete situations (Haven, 2007).

The pedagogical advantage of the narrative model is that it promotes emotional engagement, which plays a key role in the depth and durability of learning (Immordino-Yang & Damasio, 2007). Throughout the story, learners

identify with the characters and experience the consequences of their actions as they make their own decisions. This process supports the development of empathy and contributes to the formation of attitudes.

From an inclusivity perspective, narrative-based gamification is particularly beneficial because it offers multiple entry points for learners. The different roles and tasks allow learners to engage with the learning process in ways that suit their abilities and interests (Gee, 2003). In this way, the narrative model creates not only a motivating but also an inclusive educational environment.

Experience-based gamification: a model based on action and reflection

Experience-based learning is a key approach to education for sustainability, based on direct experience and its reflective processing (Kolb, 1984). In this context, gamification provides a structured framework in which learners participate as active agents in problem-solving, whilst receiving continuous feedback on their activities.

At the heart of the experience-based gamified model lies the experience of decision-making situations and their consequences. Learners are placed in situations that model real-life dilemmas, in which there is no single correct answer. This openness fosters the development of critical thinking and creates opportunities for the collision of different perspectives (Mezirow, 2000).

One of the most important elements of the model is reflection, which is an integral part of the learning process. The joint discussion, interpretation and reinterpretation of experiences enable learners to develop a deeper understanding of the complex issues of sustainability (Dewey, 1938). During the reflective process, learners consider not only external problems but also their own thinking and decisions.

Experience-based gamification is particularly effective in developing student agency. Experiencing the possibilities for action and the consequences of decisions strengthens self-efficacy, which is key to developing sustainable behaviour (Bandura, 1997). Students thus appear in the learning process not as passive recipients, but as active agents.

The social dimension is also a defining feature of this model. Cooperative tasks and collaborative problem-solving promote cooperation and social learning, which are fundamental elements of education for sustainability (Wenger,

1998). The experience-based model can thus be interpreted not only as an individual but also as a collective learning process.

Integrated model: the complex framework of gamified sustainability learning

The synthesis of narrative and experience-based approaches yields an integrated pedagogical model that effectively supports the complex objectives of education for sustainability. This integrated model utilises the structuring power of gamification to link the various dimensions of learning.

The integrated model can be understood along four fundamental dimensions:

(1) Cognitive dimension – Understanding knowledge and interrelationships related to sustainability. Learners not only acquire information but also develop systemic thinking (Sterling, 2001).
(2) Emotional dimension – Emotional engagement and attitude formation. Through narratives and experiences, learners form a personal connection with sustainability issues (Ojala, 2012).
(3) Action dimension – Developing student agency and capacity for action. The gamified environment provides opportunities to make decisions and experience their consequences (Jensen & Schnack, 2006).
(4) Community dimension – Fostering collaboration and shared visions. Learning becomes a communal process that strengthens social responsibility (Wals, 2015).

These four dimensions operate in close interaction with one another and collectively contribute to the development of sustainable thinking and behaviour. In this model, gamification is not an end in itself, but rather a pedagogical tool that structures and supports the learning process.

One of the most important features of the integrated model is inclusivity. The variety of learning pathways, roles and forms of activity enables learners to engage with the learning process by building on their own strengths. This is particularly important in heterogeneous groups of learners, where differentiated approaches play a key role.

Discussion

The combination of gamification and education for sustainability points to a pedagogical direction that goes beyond traditional methodological

innovations. Based on the models presented, gamification is not simply a tool for increasing student motivation, but a structuring framework that reorganises the logic of the learning process.

One of the fundamental problems with education for sustainability is that the learning content is often abstract, distant in time and difficult to interpret personally. Gamified learning environments, by contrast, embed the issues within concrete situations for action, so that learners engage with them not as external observers but as active participants. This shift is of fundamental importance, as sustainability is understood not primarily as knowledge but as practice.

From a motivational perspective, gamification can be considered pedagogically relevant if it reinforces the intrinsic meaning of the learning process. Autonomy, competence and the experience of relatedness are not supplementary elements, but fundamental conditions for learning (Ryan & Deci, 2000). Narrative and experience-based models support this by enabling learners to participate in decision-making, receive feedback, and interpret their experiences within a community context. In this way, learning moves beyond the logic of task completion and becomes a process of meaning-making.

The emotional dimension is particularly important in the pedagogy of sustainability. Discourse on climate change is often built on narratives of loss, uncertainty, and anxiety, which, in themselves, do not support the development of agency (Ojala, 2012; Hickman et al., 2021). In this context, gamification offers an alternative interpretative framework: it creates ‘learning situations' in which learners can experience their own impact and the consequences of their decisions. This does not diminish the gravity of the problems, but shifts the emphasis from passive reception to active interpretation.

The models presented also highlight that education for sustainability cannot be separated from the community dimension. In gamified learning environments, learning does not appear as an isolated individual activity, but as a collective process in which meanings are jointly constructed (Wenger, 1998). Shared goals, cooperative tasks, and shared experiences strengthen community responsibility, a fundamental prerequisite for sustainability.

The most important feature of the integrated model lies in its interpretation of learning as a multidimensional process. The cognitive, emotional, behavioural and community elements are not sequential steps, but form a system that operates through mutual interaction. Within this system, gamification is not a decorative element, but an organising principle that links the various learning experiences.

At the same time, however, this requires a critical approach. The pedagogical application of gamification cannot automatically be interpreted as a positive phenomenon. Solutions that rely solely on external rewards and mechanical feedback do not support the long-term goals of education for sustainability; indeed, they may even weaken intrinsic motivation (Deci et al., 1999). Gamification becomes a relevant pedagogical tool when it strengthens learners' autonomy and is not based on manipulating behaviour.

The integration of gamification and sustainability can thus be understood not as a methodological issue, but as a pedagogical approach. This is an approach that interprets learning not as a static transfer of knowledge, but as a dynamic, communal and action-oriented process. In this sense, gamified learning environments do not simply offer new tools, but rethink what it means to learn in the context of sustainability.

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