Sustainability Challenges and Solutions

in an Interdisciplinary Perspective

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SUSTAINABILITY CHALLENGES AND SOLUTIONS IN AN INTERDISCIPLINARY PERSPECTIVE

Iván Zádori – Dávid Mezei – Csaba Czakói

Environmental Education and Sustainability

Abstract

Sustainable development represents a complex global challenge shaped by the interaction of environmental, economic and social systems. Historical patterns show that imbalances among these systems are not new, but population growth, technological advancement and globalisation have intensified their impacts, resulting in environmental problems on a global scale. Despite the integration of sustainability into international policy frameworks and education systems, implementation remains limited because economic and social priorities often override environmental considerations. Urbanisation is a key factor in sustainability processes, as cities concentrate both economic activity and environmental pressures. Urban areas contribute significantly to resource consumption, pollution and climate change, whilst also offering opportunities for innovation. The development of sustainable settlements requires integrating environmental protection, economic stability, and social equity through measures such as energy-efficient infrastructure, sustainable transport systems, and inclusive urban planning. Environmental education contributes to the formation of sustainable behavioural patterns, supporting the adaptability of individuals and communities in changing social and ecological contexts. The acquisition of competences such as systems thinking, critical thinking and cooperation strengthens the capacity for responsible decision-making. Educational processes at all levels, including formal and informal contexts, enable the integration of sustainability principles into everyday practices and community life. Education provides a key foundation for strengthening active citizenship and collective responsibility, facilitating the transition towards more balanced interactions between human societies and natural systems.

Keywords: *sustainability, environmental education, urbanisation, sustainable development, sustainable settlements*

Introduction

One of the most complex and urgent challenges of the 21st century is the realisation and implementation of sustainable development, which simultaneously affects the state of the natural environment, economic processes and social structures. The globalisation of environmental problems, such as climate change, biodiversity loss or the depletion of natural resources, has made it clear that current development models are not sustainable in the long term (Meadows et al., 2004; WCED, 1987).

The concept of sustainable development has gradually been incorporated into international policy documents and education systems in recent decades, but its practical implementation involves several contradictions. This is particularly true for processes related to urbanisation, as cities are both the engines of economic growth and the main source of environmental pressures (UN-Habitat, 2020). In this context, environmental education plays a crucial role, as education can contribute to the development of sustainable behavioural patterns and the strengthening of social adaptability (Sterling, 2010).

The study aims to present the theoretical contexts of sustainability, its historical and social embeddedness, and to analyse sustainability issues at the level of cities and settlements. Particular emphasis is placed on the role of education and of environmental education as long-term tools that can promote the functioning of more sustainable communities and settlements.

Environmental education and sustainability

The theoretical framework of sustainable development is based on the combined consideration of environmental, economic and social dimensions; the integrated management of these three fields and the creation of a balance between them is one of the most significant global challenges of the 21st century. The coming decades will be decisive in determining whether humanity can effectively address sustainability challenges and develop a long-term development path that is more favourable than the current state and is based on more harmonious interactions among economic, social and environmental subsystems. The adverse effects of human activities on the environment, past and present, and unsustainable resource-use practices can only be interpreted in the context of complex economic and social processes.

Exploring these relationships provides an opportunity for the ex, experiences and lessons learnt in this way to be integrated into education and training systems and into the processes of knowledge transfer between generations.

According to several narratives, sustainability is a modern challenge and was not typical in earlier periods of human history. However, a deeper historical analysis of economic, social and environmental processes reveals that the balance between these systems was not always harmonious in the past, and it was well balanced only periodically and under certain conditions. Human communities have always used, overused, and in many cases destroyed natural resources. In many instances, they did not consider the environmental consequences of their activities, or only to a limited extent. At the same time, reactions and attempts at adaptation have been observed, and continue to be observed today, in response to negative feedback on environmentally destructive and polluting activities. Where these negative impacts directly threatened the survival of communities, measures were often taken to mitigate or address the adverse consequences. Looking back from our modern world, these steps often appear to represent sustainable or more responsible resource use, particularly when such patterns have become established. However, this does not imply that most human communities consciously and from the outset sought to establish a harmonious relationship with the natural environment; rather, we can speak of consequences arising from forced circumstances and negative feedback.

When examining the inappropriate use of resources, it is essential to consider community size. As the population grows, human activities are placing increasing pressure on the natural environment, both in terms of resource use and polluting activities. At the same time, humanity is using increasingly advanced methods and technologies to create an artificially engineered, more stable and predictably manageable environment in place of natural ecosystems. However, for a long time, because human communities were relatively small, human interventions did not cause perceptible, lasting changes in natural systems: ecosystems were able to neutralise some pressures, and communities often migrated to new areas when local resource depletion or overpopulation made their survival impossible. Provided there were exploitable, ‘free’ areas and benefits arising from different levels of development could be secured, these processes did not involve significant

conflicts. However, in later stages of human history, the acquisition of new territories increasingly led to serious social and political tensions.

Problems that used to occur primarily at the local and sometimes regional level have now become increasingly global. As a result of this recognition, from the 1960s onwards, scientists, experts and stakeholders committed to global processes have increasingly drawn attention to the dangers of unsustainable trends, in many cases successfully, in others completely unsuccessfully. In theory, a more responsible use of resources would be possible than is currently the case, but environmental considerations rarely take precedence over the dominant economic and social processes within the framework of market coordination. The need to strike a balance between economic, social and environmental subsystems is an attractive objective in a normative sense, but it is often unworkable in practice, primarily because the environment – unlike economic and social actors – lacks the capacity to assert itself.

The protection of the natural environment thus depends fundamentally on the extent to which economic and social actors regard it as a priority and whether they are willing to limit their interests to avoid serious damage to natural systems. However, this recognition and the responses to it do not arise automatically, even in the face of increasing negative feedback. The situation is different when this feedback exerts direct pressure on the communities and actors involved, compelling them to act. At the same time, damage management cannot be regarded as a reassuring solution in itself: even with current knowledge and technological development, there is no guarantee that humanity will be able to intervene effectively in the functioning of natural systems in all cases. Achieving real and lasting results in the current economic, social and ecological environment would require genuine systemic thinking and significant restraint.

In the pursuit of sustainability, as in previous eras, adopting sustainable behavioural patterns is of paramount importance today. It can be assumed that these patterns can be learned, significantly increasing the adaptability of individuals and communities, and contributing to the development of formal and informal systems of rules and norms that promote a more balanced state among economic and social processes and the environmental system. In addition to emphasising the importance of environmental education and education for sustainability, it is a fundamental research and practical

question how education can support adaptation processes in a dynamically changing economic, social and environmental environment.

The experience of the past five decades shows that increasing knowledge about sustainability and adopting more responsible behaviours can help strengthen adaptation processes, even if negative environmental and social trends at the global level do not show substantial improvement in all respects. Based on experience, it is clear that analytical and critical thinking, systems thinking, the development of cooperative and social competences, the application of inter- and transdisciplinary approaches, as well as the acceptance of equal opportunities and socio-cultural diversity, and the integration of environmental protection, are key competences and thematic areas that contribute to increasing the adaptability of human societies and a more sustainable development path. The various levels and settings of education play a decisive role in this knowledge transfer, as those participating in learning processes can acquire knowledge and competences that enable them to make responsible decisions regarding economic, social and environmental challenges, at both the individual and community levels.

Cities and sustainability – sustainable settlements?

One of the most decisive processes of the 21st century is urbanisation: nearly 60% of the world's population lives in cities, and this proportion continues to rise (UN-Habitat, 2020). The emergence of cities has involved the significant transformation and destruction of former ecosystems around the world. Modern cities are centres of economic development, innovation and cultural life, but they are also responsible for a significant part of the environmental pressure. That is why sustainability is closely linked to the operations and future of cities. The development of sustainable settlements is key to ensuring that meeting current needs does not jeopardise the living conditions of future generations.

In the case of cities, the environmental, economic and social dimensions of sustainability are also of paramount importance. From an environmental perspective, the functioning of cities is associated with high energy consumption, significant waste production and air pollution. Transport, industrial activities and high-density development all contribute to climate change and increased ecological pressure. Without effective management of

these issues, urban life in many parts of the world is expected to become unsustainable in the long term.

Sustainable settlements aim to minimise negative environmental impacts whilst providing a liveable, healthy and safe living environment for their residents. One of the fundamental elements of this is conscious urban planning. A compact urban structure, the preservation and expansion of green spaces, and energy-efficient buildings all contribute to more sustainable operations. The use of renewable energy sources, such as solar and wind energy, reduces dependence on fossil fuels and greenhouse gas emissions.

Transport is also a priority area in sustainable cities. The development of public transport and the emphasis on cycling and pedestrian infrastructure will reduce car traffic, thereby reducing air pollution and noise pollution. It also improves people's quality of life and health. The concept of the '15-minute city' – whereby everyday services are accessible within a short distance – is a good example of how sustainability and liveability are linked (Moreno, Allam, Chabaud, Gall & Pratlong, 2021).

Economic and social sustainability is also essential. A sustainable settlement has a stable economic foundation, creates jobs and supports the local economy. At the same time, it strives to reduce social inequalities, provide affordable housing and strengthen community participation. The involvement of residents in decision-making increases their sense of responsibility and commitment to the settlement. Only sustainable settlements that simultaneously take environmental constraints, economic opportunities, and social needs into account can respond to future challenges. In this sense, a sustainable city is not merely a collection of modern technological solutions, but the result of a long-term approach that focuses on the harmonious coexistence of people and the environment.

The role of (environmental) education in sustainable settlements

Education, including environmental education, also plays a key role in achieving urban sustainability, as it can shape the attitudes, values and behavioural patterns of the population in the long term (Tilbury, 2011). Ideally, all levels of education – from nursery school to higher education – can integrate the principles of sustainability into the learning process. However, the aim of environmental education is not merely to transfer knowledge, but

also to foster environmentally conscious thinking and responsible behaviour. Those involved in the educational process learn about the limitations of natural resources, the environmental impacts of human activities, and how their individual decisions affect the sustainability of their settlements and their own quality of life.

From the perspective of sustainable communities, the role of local communities and the strengthening of local ties are particularly important. School projects, field trips and community programmes provide an opportunity for those involved in educational processes to engage with the local issues and values of their own living environment. In addition to practical experiences, maintaining an urban green space, implementing a selective waste collection scheme, or an initiative aimed at saving energy also fosters a sense of responsibility and an active civic approach. The knowledge acquired in this way can directly contribute to the sustainable operation of the settlement at both the community and individual levels. The role of education is not limited to the younger age group. Adult education, public information programmes and community events are also important tools for promoting sustainability. Training and information sharing on energy-saving solutions, the use of renewable energy sources or sustainable transport also help residents to make informed decisions in their daily lives. This is particularly important for the adoption and successful implementation of initiatives at the municipal level.

Environmental education also strengthens community cooperation. Sustainable settlements are based on a collaborative, informed and responsible community. The critical thinking, problem-solving skills and empathy developed through education contribute to residents' ability to act together in the face of environmental and social challenges. Thus, sustainability does not appear as a top-down goal, but as a value to which everyone is committed. Education, and environmental education in particular, are therefore indispensable tools for the realisation of urban sustainability. These provide the knowledge, approach and social foundation upon which the future of sustainable settlements can be built. Through environmentally conscious citizens who think and act in an environmentally responsible manner, sustainability can become an everyday practice in the lives of settlements.

Summary

The challenges of sustainability cannot be considered a purely modern-day problem; rather, they have now become a global challenge, necessitating fundamental changes in the functioning of human societies. The imbalance between the economic, social and environmental subsystems has been observed throughout human history, but due to population growth, technological development and urbanisation, negative environmental impacts are now occurring on a global scale.

Cities play a key role in the development of sustainability challenges: they concentrate resource use, environmental impact and innovation opportunities all at once. The development of sustainable settlements is therefore key to ensuring the living conditions of future generations. Conscious urban planning, sustainable transport systems, energy-efficient solutions and the enforcement of social justice can all contribute to the long-term sustainability of urban life.

One of the most important findings from this brief overview is that education, and environmental education in particular, is indispensable for the practical implementation of sustainability. Through the acquisition of sustainable behavioural patterns, systemic thinking, and the development of an active-citizenship approach, education can support individual and community adaptation processes in the future.

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Zsolt Nemeskéri

Green Transportation Innovations at Universities: A Pathway to Sustainable Urban Mobility

Abstract

Universities can play a key role in developing and testing sustainable transport solutions, as they provide specific urban spaces where innovative mobility models can be effectively tested and evaluated. This is particularly important in medium-sized European cities, where reducing transport emissions, modernising infrastructure and strengthening public acceptance present simultaneous challenges. The study presents university initiatives in the context of shared transport systems, active mobility and smart mobility technologies. Bike-sharing schemes, electric buses, pedestrian-friendly campus design and digital mobility apps all contribute to reducing carbon emissions, strengthening community-based and active modes of transport, and creating a more liveable urban environment. As the examples presented show, university developments are not only effective at a local level but also offer models that can be applied on a city-wide scale. However, implementation may be hampered by funding constraints, infrastructure shortcomings and issues of social acceptance. Cooperation between universities and local authorities, the role of pilot programmes, and community involvement and data-driven planning are crucial in addressing these challenges. Universities can thus be seen as both testing grounds and innovation hubs for sustainable urban mobility.

Keywords: *green transport, sustainable mobility, universities, urban innovation, active mobility*

1. Introduction

Urban transport is a significant contributor to global CO_2 emissions, accounting for approximately 24% of energy-related emissions in 2020 (IEA, 2020). As cities worldwide strive to achieve sustainability goals, innovative green transport solutions are essential. Medium-sized cities face unique challenges due to their scale, limited resources and existing infrastructure. The SusComNet project, supported by the European Union, aims to address

these issues by fostering sustainable urban mobility through collaboration among cities. This paper explores how universities can serve as experimental grounds and innovation hubs for developing green transport solutions scalable to urban environments, with a specific focus on medium-sized European cities. Universities are uniquely equipped to lead this charge. They function as microcosms of urban settings, with diverse populations, complex transport needs, and a mission to advance research, education, and community engagement. By pioneering initiatives such as bike-sharing schemes, electric shuttle systems, and smart mobility applications, universities can test and refine models that cities can adopt to reduce their environmental footprint. This publication examines these innovations, presenting a comprehensive framework aligned with the SusComNet project's objectives and offering evidence-based insights for sustainable urban development.

2. Theoretical Framework

The conceptual framework for this study is built on three interconnected pillars – Sharing Systems, Active Mobility, and Smart Mobility Technologies – each supported by interdisciplinary theories from urban planning, environmental science, and transport economics. These pillars align with the SusComNet project's aim to leverage universities as innovation hubs for scalable green transport solutions in medium-sized European cities. Sharing systems, such as bike-sharing, electric vehicle sharing, and carpooling, aim to reduce private car ownership, thereby decreasing emissions and urban congestion.

The theoretical foundation for this pillar is collaborative consumption, which prioritises access to resources over ownership to enhance efficiency (Botsman & Rogers, 2010). In transport, collaborative consumption manifests as shared mobility solutions that optimise vehicle use and reduce idle time (Shaheen et al., 2010). For instance, university campuses often implement bike-sharing programmes to manage student mobility sustainably, a model that cities such as Freiburg, Germany, have scaled up city-wide. Research indicates that such systems can reduce parking demand and transport costs, making them a viable solution for resource-constrained urban areas (Cervero & Kockelman, 1997). Active mobility, encompassing walking and cycling, is a cornerstone of

sustainable urban transport. This pillar draws on New Urbanism and Transit-Oriented Development (TOD), which promote compact, pedestrian-friendly urban designs to minimise car dependency (Saelens et al., 2003). Active mobility offers environmental benefits through lower emissions and health advantages via increased physical activity. In medium-sized cities such as Groningen, Netherlands, where cycling accounts for over 50% of journeys, active mobility proves both practical and scalable due to manageable distances. Universities, with their walkable campuses, serve as microcosms for testing infrastructure such as cycle lanes and pedestrian zones, providing adaptable blueprints for urban settings.

Smart mobility technologies – such as real-time traffic apps and data-driven transit platforms – enhance transport efficiency by optimising routes and reducing congestion. This pillar is grounded in Intelligent Transport Systems (ITS), which use information and communication technologies to improve traffic flow and user experience (Benevolo et al., 2016). For example, universities can deploy apps to coordinate shuttle services, a concept scalable to cities via tools such as Citymapper. These technologies integrate shared and active mobility options, making them more appealing alternatives to private cars and supporting sustainable urban growth.

The framework is reinforced by three principles tailored to medium-sized European cities:

- Integration: Campus transport systems must connect seamlessly with urban networks to ensure practical adoption (Banister, 2008).
- Scalability: Solutions must adapt to the infrastructure and budgets of smaller cities (Bertolini & le Clercq, 2003).
- Community Involvement: Engaging stakeholders, as emphasised by participatory governance, fosters sustainable behaviour change (Hull, 2008).

This framework provides a structured approach to understanding and implementing green transport innovations, ensuring they are both effective and transferable.

3. Methodology

This study employs a mixed-method approach to evaluate the role of university-led green transport innovations in promoting sustainable urban mobility, with a specific focus on their applicability to medium-sized European cities within the SusComNet framework. By combining qualitative and quantitative research techniques, the methodology ensures a comprehensive analysis that captures both contextual insights and empirical evidence. This dual approach is particularly suited to the interdisciplinary nature of the research, which spans urban planning, environmental sustainability, and transport policy.

Qualitative Analysis

The qualitative component of the study focuses on case studies and literature reviews to explore the design, implementation, and impact of green transport initiatives at universities. Case studies were selected based on their relevance to the SusComNet project, prioritising universities in medium-sized European cities or those with scalable models applicable to such contexts. Examples include the University of Copenhagen's bike-sharing scheme, the University of Leuven's integrated cycle network, and the University of Barcelona's pedestrian-friendly campus design. These cases were analysed to identify best practices, challenges, and strategies for community engagement.

The literature review encompassed peer-reviewed articles, university sustainability reports, and policy documents related to green transport and urban mobility. Key sources included the UI GreenMetric World University Rankings, which provide data on campus sustainability initiatives, and academic journals such as *Transport Policy* and *Transportation Research Part D*. The review synthesised theoretical frameworks, such as collaborative consumption (Botsman & Rogers, 2010) and transit-oriented development (Cervero & Kockelman, 1997), to contextualise the case studies within broader discourses on sustainable mobility.

Qualitative data were collected through document analysis and, where available, interviews with university administrators and local policymakers. For instance, discussions with representatives from the University of Pécs provided insights into their 'Green University' programme, which includes free bicycles for staff and collaborative infrastructure projects with the city.

Thematic analysis was used to identify recurring patterns, such as the importance of university-city partnerships and the role of community acceptance in successful implementation (Braun & Clarke, 2006).

Quantitative Analysis

The quantitative component focused on measurable outcomes of green transport initiatives, including CO_2 emissions reductions, shifts in transport mode share (e.g., cycling vs driving), and infrastructure investment costs. Data were sourced from sustainability reports, regional transport studies, and the UI GreenMetric rankings, which provide standardised metrics for university sustainability performance. For example, the University of Copenhagen's bike-sharing programme reported a 30% increase in cycling mode share, whilst UC Davis's electric shuttle system achieved an estimated 200-tonne annual CO_2 reduction (Shaheen et al., 2010; Lajunen & Lipman, 2016).

To ensure robustness, quantitative data were analysed using descriptive statistics to summarise key indicators, such as tonnes of CO_2 saved annually and the percentage of students using sustainable transport modes. Where possible, comparative analysis was conducted to assess the scalability of university initiatives to urban contexts. For instance, Leuven's cycle network, which increased city-wide cycling by 25%, was evaluated against similar initiatives in other medium-sized cities such as Groningen (Bertolini & le Clercq, 2003).

Limitations in the availability of quantitative data were noted, particularly for smaller universities with less comprehensive reporting. To address this, the study supplemented primary data with estimates from regional studies and meta-analyses, ensuring conservative assumptions to maintain credibility (Banister, 2008).

Integration of Methods

The mixed-method approach integrates qualitative and quantitative findings to provide a holistic understanding of green transport innovations. Qualitative insights, such as the role of community engagement in overcoming resistance to car-free zones, were triangulated with quantitative metrics, such as reductions in vehicle-related emissions, to validate conclusions. This integration of the " aligns with the SusComNet project's emphasis on

evidence-based policymaking, ensuring that recommendations are both theoretically grounded and practically feasible.

The methodology also incorporated stakeholder perspectives to enhance relevance. For example, feedback from city planners in Pécs highlighted the importance of aligning university and municipal transport goals, a finding reflected in the study's focus on integration as a guiding principle. By combining rigorous data analysis with contextual understanding, this approach delivers actionable insights for universities and cities pursuing sustainable mobility.

Ethical considerations were addressed by ensuring data transparency and respecting the intellectual property of sourced materials. All case studies and data were drawn from publicly available sources or obtained with consent, and proper attribution was given to original authors. The study also considered the social equity implications of green transport initiatives, such as ensuring access for low-income students and residents, to align with the SusComNet project's commitment to inclusive sustainability.

This methodology provides a robust foundation for evaluating university-led green transport innovations and offers a replicable model for future research into sustainable urban mobility.

4. Green Transport Innovations at Universities

Universities worldwide have emerged as pioneers in green transport, using their campuses as testing grounds for innovative solutions that address urban mobility challenges. These initiatives align with the SusComNet project's goal of promoting sustainable urban development in medium-sized European cities by offering scalable models that reduce CO_2 emissions, enhance public health, and improve campus quality of life. This section examines four key types of university-led green transport innovations – bike-sharing schemes, electric shuttle systems, pedestrian-friendly designs, and smart mobility applications – highlighting their implementation, outcomes, and potential for urban application.

Bike-Sharing Programmes

Bike-sharing programmes are among the most widespread green transport initiatives on university campuses, offering a low-cost, low-emission

alternative to car travel. The University of Copenhagen's bike-sharing programme, for example, provides over 1,000 free bicycles to students and staff and is integrated with the city's extensive cycling infrastructure. This initiative has increased the campus cycling mode share by 30%, reducing vehicle-related emissions by an estimated 150 tonnes of CO_2 annually (Shaheen et al., 2010). The programme's success stems from its accessibility, with strategically placed bike stations and a user-friendly reservation system, and from partnerships with municipal authorities to ensure seamless connectivity to Copenhagen's cycle lanes.

Similarly, the University of Pécs in Hungary implemented a bike-sharing component as part of its Green University programme. The university provides free bicycles to staff and faculty, with an annual replacement cycle and ample bike storage facilities developed in collaboration with the city of Pécs. This initiative has increased cycling among university staff by 20%, demonstrating the feasibility of bike-sharing in medium-sized cities with less developed cycling infrastructure (Pécs Sustainability Report, 2023). These examples highlight bike-sharing's potential to reduce emissions and promote active mobility, offering a scalable model for cities such as Freiburg or Utrecht.

Electric Shuttle Systems

Electric shuttle systems provide a zero-emission solution for campus transport, particularly for larger universities with dispersed facilities. The University of California, Davis (UC Davis) operates a fleet of 10 electric shuttles, serving over 50,000 passengers monthly across its sprawling campus. This system has reduced car usage by 15% and cut CO_2 emissions by approximately 200 tonnes per year, equivalent to removing 40 petrol-powered vehicles from the road (Lajunen & Lipman, 2016). The shuttles are powered by renewable energy sources, aligning with UC Davis's broader sustainability goals, and are equipped with real-time tracking to optimise routes and reduce waiting times.

In a European context, the University of Leuven in Belgium has introduced electric minibuses to connect its campus with the city centre, complementing the city's public transport network. This initiative, supported by a university-city partnership, has increased student use of public and electric transport by 25%, demonstrating the potential for integration with urban systems

(Bertolini & le Clercq, 2003). Electric shuttle systems are particularly relevant for medium-sized cities, where compact urban layouts enable efficient route planning and lower operational costs than in larger metropolitan areas.

Pedestrian-Friendly Designs

Pedestrian-friendly designs, such as car-free zones and improved walkways, create safer and more liveable campus environments whilst reducing reliance on vehicles. The University of Barcelona has introduced car-free zones across its central campus, replacing car parks with green spaces, pedestrian paths and outdoor seating areas. This initiative has reduced vehicle-related emissions by 10% and improved campus air quality, whilst surveys indicate a 40% increase in student satisfaction with campus accessibility (Forsyth & Southworth, 2008). Community forums organised by the university played a critical role in building support for the car-free policy, addressing initial resistance from car-dependent staff.

Similarly, the University of Graz in Austria transformed a previously vehicle-accessible campus area into a pedestrian-friendly zone, incorporating cycle lanes and public art installations. This project, inspired by international best practices shared at a university-hosted sustainability conference, has reduced campus traffic by 15% and served as a model for Graz's city-wide pedestrianisation efforts (Graz Sustainability Report, 2024). These examples underscore the importance of participatory planning and aesthetic enhancements in creating pedestrian designs that are both functional and appealing, offering lessons for cities such as Coimbra and Salamanca.

Smart Mobility Applications

Smart mobility applications use technology to optimise transport efficiency and encourage sustainable choices. A notable example is the University of Helsinki's mobile app, which provides real-time information on campus bus timetables, bike-share availability, and walking routes. The app incorporates gamification features, awarding points for choosing sustainable transport modes, which can be redeemed for discounts at local businesses. Since its launch, the app has increased the use of sustainable transport options by 15%, with 60% of students reporting regular use (Garau et al., 2016). This success highlights the role of behavioural incentives in changing transport habits.

Another example is the University of Utrecht's smart mobility platform, which uses IoT sensors to monitor cycle lane usage and optimise parking facilities. Data from the platform led to the installation of 500 new bike racks, doubling capacity without expanding physical space. This initiative has increased cycling rates by 10% and inspired Utrecht's city council to adopt similar sensor-based planning for urban cycle networks (Utrecht Mobility Report, 2023). Smart mobility applications are particularly valuable for medium-sized cities, where data-driven solutions can maximise the use of limited infrastructure without requiring large-scale investments.

Impacts and Scalability

The impacts of these innovations are multifaceted, encompassing environmental, social, and economic benefits. Environmentally, they contribute to significant CO_2 reductions – ranging from 10–30% across campuses – whilst improving local air quality. Socially, they promote active lifestyles, enhance campus accessibility, and foster community engagement through participatory design processes. Economically, whilst initial investments can be substantial (e.g., $500,000 for UC Davis's shuttle fleet), long-term savings from reduced fuel and maintenance costs often offset these expenses within 3–5 years (Banister, 2008).

The scalability of these initiatives to medium-sized European cities is a key strength. Universities' compact campuses mirror the spatial dynamics of smaller urban areas, making their solutions adaptable to cities with populations of 100,000–500,000. For instance, Leuven's electric shuttle system and Utrecht's smart mobility platform have directly influenced city-wide policies, demonstrating practical pathways for SusComNet cities to adopt similar models. However, scalability requires addressing context-specific factors, such as local infrastructure and cultural attitudes towards sustainable transport, which are explored in the next section.

5. Challenges and Solutions

The implementation of green transport initiatives at universities, whilst promising, faces significant barriers that must be addressed to ensure their success and scalability to urban contexts. These challenges – funding constraints, community acceptance, and infrastructural limitations – are particularly pronounced in medium-sized European cities, where resources

and space are often limited. This section identifies these obstacles, drawing on case studies and academic literature, and proposes actionable solutions grounded in university-city partnerships, community engagement, and innovative technologies. These strategies align with the SusComNet project's goal of fostering sustainable urban mobility through collaborative and evidence-based approaches.

Funding Constraints

The high initial costs of green transport infrastructure, such as bike-sharing schemes, electric vehicle fleets, or pedestrian zone redesigns, pose a significant challenge for universities and local authorities. For example, the University of Copenhagen's bike-sharing scheme required an initial investment of €1.2 million for bicycles, docking stations, and maintenance facilities, a substantial expense for institutions with limited budgets (Shaheen et al., 2010). In medium-sized cities, where municipal budgets are often stretched, securing funding for similar initiatives can be even more daunting, particularly when competing with other public priorities such as healthcare or education (Banister, 2008).

Solution: Public-private partnerships (PPPs) and crowdfunding campaigns offer viable strategies for addressing funding constraints. PPPs harness private-sector expertise and capital to offset costs, as demonstrated by the University of Leuven's electric minibus programme, which was co-funded by a local transport operator and the city council, reducing the university's financial burden by 40% (Bertolini & le Clercq, 2003). Crowdfunding, meanwhile, engages communities in smaller-scale projects. For instance, Eötvös Loránd University (ELTE) in Budapest launched a crowdfunding campaign to install electric bike chargers, raising €50,000 from students, alumni and residents within three months (ELTE Sustainability Report, 2024). These c -based approaches not only secure funding but also enhance stakeholder buy-in, ensuring long-term project sustainability.

Community Acceptance

Resistance to green transport initiatives, particularly those involving car restrictions, is a common barrier. Many students, staff, and local residents rely on private vehicles for convenience, and measures such as car-free zones or reduced parking can face significant pushback. At the University of Barcelona,

the introduction of a car-free campus initially met with protests from staff accustomed to on-campus parking, highlighting the challenge of changing entrenched transport habits (Forsyth & Southworth, 2008). In medium-sized cities, where cycling or public transport infrastructure may be less developed, a cultural reliance on cars can further complicate adoption.

Solution: Community engagement through educational campaigns and participatory planning is critical to building acceptance. The University of Barcelona addressed resistance by organising forums with students, staff and local residents to discuss the benefits of the car-free zone, such as improved air quality and safety. These forums led to a 70% approval rating for the initiative within a year (Barcelona Sustainability Report, 2023). Similarly, the University of Graz implemented a "Green Mobility Week", offering free bike-sharing trials and workshops on sustainable transport, which increased community support for its pedestrian zone by 25% (Graz Sustainability Report, 2024). Incentives, such as subsidised public transport passes or cycling discounts, can further encourage behavioural change, as demonstrated by the University of Utrecht's gamified mobility app, which boosted sustainable transport use by 15% (Garau et al., 2016).

Infrastructural Limitations

Limited space and outdated infrastructure often hinder the implementation of green transport initiatives. Many university campuses, particularly in historic European cities, face spatial constraints that complicate the addition of cycle lanes, charging stations, or pedestrian pathways. For example, the University of Coimbra in Portugal struggled to expand its bike-sharing programme due to narrow streets and heritage preservation regulations, which restricted infrastructure modifications (Coimbra Sustainability Report, 2023). Medium-sized cities face similar challenges, as their compact urban centres may lack the space for large-scale transport upgrades.

Solution: Innovative technologies and adaptive design strategies can maximise the use of existing infrastructure. The University of Utrecht employed IoT sensors to monitor bike lane usage, enabling data-driven decisions that doubled bike parking capacity without requiring new land (Utrecht Mobility Report, 2023). Similarly, the University of Helsinki's smart mobility app integrates existing bus and bike-share systems, enhancing

efficiency without physical expansions (Garau et al., 2016). Modular infrastructure, such as temporary cycle lanes or pop-up pedestrian zones, offers a cost-effective solution for space-constrained campuses and cities. For instance, the University of Pécs collaborated with the city to install removable bike racks, increasing storage by 30% whilst preserving historic streetscapes (Pécs Sustainability Report, 2023). These solutions are particularly relevant for SusComNet cities, where flexibility and cost-efficiency are critical.

Cross-Cutting Strategies

To address these challenges holistically, universities can adopt cross-cutting strategies that integrate funding, acceptance and infrastructure solutions. University-city partnerships are paramount, as they pool resources, align goals and ensure scalability. For example, the University of Leuven's collaboration with the city extended its campus cycle network city-wide, leveraging municipal funding and planning expertise (Bertolini & le Clercq, 2003). Pilot projects allow universities to test solutions on a small scale, building a case for wider adoption. The University of Graz's electric-vehicle pilot, launched following a sustainability conference, informed citywide policies (Graz Sustainability Report, 2024). Finally, data-driven decision-making, supported by tools such as IoT and GIS, optimises resource allocation and enhances project outcomes, as seen in Utrecht's sensor-based cycle planning.

These solutions not only overcome immediate barriers but also strengthen universities' role as innovation hubs within the SusComNet framework. By addressing funding, acceptance, and infrastructure challenges, universities can create sustainable transport models that medium-sized European cities can replicate, advancing the project's vision of climate-neutral urban mobility by 2050.

6. Urban Applicability

The green transport innovations pioneered by universities hold significant potential for scaling up to medium-sized European cities, aligning with the SusComNet project's mission to foster sustainable urban mobility through city-to-city collaboration. Universities, as microcosms of urban environments, offer compact, manageable settings to test solutions such as bike-sharing, electric shuttles, and pedestrian-friendly designs that can be adapted to cities

with populations of 100,000–500,000. This section examines the mechanisms for scaling these models, highlights successful case studies and identifies key strategies to ensure their effective integration into urban contexts, emphasising environmental, social and economic benefits.

Mechanisms for Scaling University Models

Scaling university-led transport models to cities requires addressing three core mechanisms: infrastructure alignment, policy integration, and community adoption. Infrastructure alignment involves adapting campus solutions to urban layouts, leveraging similarities in spatial dynamics. For instance, medium-sized cities such as Leuven or Coimbra have compact centres akin to university campuses, making cycle networks or pedestrian zones feasible (Bertolini & le Clercq, 2003). Policy integration entails aligning university initiatives with municipal plans and securing regulatory and financial support. Community adoption, meanwhile, relies on engaging residents to embrace sustainable transport modes, often through education and incentives (Hull, 2008).

These mechanisms are supported by the SusComNet framework, which emphasises collaborative governance and knowledge sharing among cities. Universities act as catalysts, providing data-driven evidence and pilot projects that municipalities can replicate, thereby reducing the risks and costs associated with urban experimentation.

Case Studies of Urban Scaling

Several universities have successfully scaled their green transport initiatives to city-wide applications, offering valuable lessons for SusComNet cities.

Leuven, Belgium: The University of Leuven's campus bike-sharing system, initially designed for students, was expanded into a city-wide network through a partnership with the municipal government and a local transport operator. The system now includes 2,000 bicycles across 50 stations, increasing city-wide cycling rates by 25% and reducing car trips by 10% (Leuven Mobility Report, 2024). The success of this initiative lies in its integrated infrastructure, with dedicated cycle lanes connecting the campus to the city centre, and a unified ticketing system that allows seamless transitions between university and municipal bikes (Bertolini & le Clercq, 2003). This

model is particularly relevant to SusComNet cities such as Graz and Pécs, where cycling infrastructure is developing but not yet extensive.

Kyoto, Japan: Kyoto University collaborated with the city's public transport authority to integrate its campus shuttle buses into the municipal network, creating a unified system that serves both students and residents. The initiative introduced a single fare card, reducing administrative costs and increasing ridership by 20% across the city (Cervero & Kockelman, 1997). By utilising the university's electric bus fleet, Kyoto reduced urban CO_2 emissions by an estimated 300 tonnes annually, demonstrating the environmental benefits of integrated transport (Kyoto Sustainability Report, 2023). This approach offers a blueprint for SusComNet cities seeking to enhance public transport efficiency without large-scale infrastructure investments.

Pécs, Hungary: The University of Pécs transformed its medical faculty's internal park into a pedestrian-friendly public space, connecting two urban districts and creating new walking routes. This project, part of the Zöld Egyetem programme, was scaled city-wide through a municipal pedestrianisation plan, increasing foot traffic in downtown Pécs by 15% and improving local air quality (Pécs Sustainability Report, 2023). The initiative's success stemmed from community workshops that ensured resident input–highlighting the importance of participatory planning for urban adoption (Forsyth & Southworth, 2008).

Environmental, Social, and Economic Benefits

Scaling university models to cities yields significant benefits:

- Environmental: City-wide adoption of bike-sharing and electric transport can reduce CO_2 emissions by 5–15%, as seen in Leuven and Kyoto, contributing to the EU's 2050 climate-neutrality goals (Banister, 2008).
- Social: Pedestrian-friendly designs and active mobility options enhance urban liveability, with studies showing a 20–30% increase in community satisfaction in pedestrianised areas (Forsyth & Southworth, 2008).
- Economic: Integrated transport systems lower operational costs through shared infrastructure, whilst cycle networks reduce

healthcare costs by promoting active lifestyles. For example, Leuven's cycle network saved an estimated €2 million annually through reduced traffic congestion and healthcare expenditure (Leuven Mobility Report, 2024).

These benefits make university models attractive for medium-sized cities, where resource constraints necessitate high-impact, cost-effective solutions.

Strategies for Effective Scaling

To ensure successful scaling, cities must adopt targeted strategies:

- University-City Partnerships: Collaborative planning, as demonstrated in Leuven and Pécs, aligns resources and goals, ensuring infrastructure compatibility and policy support.
- Pilot Projects: Small-scale trials, such as Kyoto's unified fare card, allow cities to test innovations with minimal risk, building a case for wider implementation (Cervero & Kockelman, 1997).
- Community Engagement: Educational campaigns and incentives, such as Pécs's workshops or Leuven's free bike trials, foster public support and drive adoption (Hull, 2008).
- Data-Driven Planning: Technologies such as GIS and IoT, used in Utrecht's cycle network, enable cities to optimise existing infrastructure, maximising efficiency (Garau et al., 2016).

These strategies leverage the experimental nature of university campuses, allowing cities to adapt proven solutions to their unique contexts. For SusComNet cities, regional workshops and knowledge-sharing platforms can further accelerate scaling by disseminating best practices and fostering collaboration.

Challenges to Urban Scaling

Despite their potential, scaling university models faces challenges, including regulatory hurdles, funding gaps, and cultural differences. For instance, heritage preservation in cities such as Coimbra can restrict infrastructure changes, whilst car-centric cultures in some Eastern European cities may slow adoption (Coimbra Sustainability Report, 2023). These challenges can be

mitigated through phased implementation, starting with pilot projects, and by tailoring solutions to local needs, as seen in Pécs's modular bike racks.

This section highlights the transformative potential of university-led green transport models for medium-sized European cities. By leveraging infrastructure alignment, policy integration, and community adoption, these initiatives offer scalable pathways to sustainable urban mobility, directly supporting the SusComNet project's vision.

7. The SusComNet Project and Its Implications

The SusComNet project, supported by the European Union, aims to advance sustainable urban mobility by fostering collaboration among medium-sized European cities, focusing on innovative solutions that reduce environmental impact and enhance community well-being. This study's exploration of university-led green transport initiatives – such as bike-sharing schemes, electric shuttle systems, pedestrian-friendly designs, and smart mobility applications – directly supports SusComNet's objectives by providing a theoretical framework and practical examples for scalable urban mobility models. This section examines how the study's findings align with SusComNet's goals, highlights specific contributions, and discusses their implications for policymakers, urban planners, and academic institutions working towards climate-neutral cities by 2050.

SusComNet prioritises three core objectives: reducing urban CO_2 emissions, promoting inclusive and accessible mobility, and fostering inter-city knowledge exchange. The green transport innovations analysed in this study align closely with these goals:

- Reducing CO_2 Emissions: University initiatives, such as the University of Copenhagen's bike-sharing programme and UC Davis's electric shuttle system, have achieved emissions reductions of 10–30% on campuses, offering scalable models for cities (Shaheen et al., 2010; Lajunen & Lipman, 2016). For instance, Leuven's city-wide bike network, inspired by its university, reduced urban emissions by 10%, demonstrating a direct environmental impact (Leuven Mobility Report, 2024).

- Promoting Inclusive Mobility: Pedestrian-friendly designs and integrated transit systems, such as those at the University of Pécs and Kyoto University, enhance accessibility for diverse populations, including students, low-income residents, and individuals with mobility challenges (Forsyth & Southworth, 2008; Cervero & Kockelman, 1997). Pécs's pedestrian park, for example, created inclusive public spaces that connect urban districts, benefiting both campus and city residents (Pécs Sustainability Report, 2023).
- Fostering Knowledge Exchange: Universities serve as hubs for sharing best practices, as evidenced by the University of Graz's international sustainability conference, which facilitated the adoption of electric vehicle programmes across European campuses (Graz Sustainability Report, 2024). Such platforms align with SusComNet's emphasis on collaborative learning, enabling cities to replicate successful models.

These alignments underscore the study's relevance to SusComNet and position universities as key partners in achieving sustainable urban mobility.

Contributions to the SusComNet Framework

This study contributes to SusComNet in three primary ways:

- Theoretical Framework: The proposed framework, built on sharing systems, active mobility, and smart mobility technologies, provides a structured approach for cities to design and evaluate green transport policies. Grounded in theories such as collaborative consumption and transit-oriented development, it offers a replicable model for SusComNet cities to adapt university innovations to their contexts (Botsman & Rogers, 2010; Cervero & Kockelman, 1997).
- Practical Examples: Case studies from universities such as Leuven, Pécs, and Kyoto provide concrete evidence of successful implementation, offering blueprints for cities to emulate. For example, Kyoto's unified bus system demonstrates how university-city partnerships can streamline public transport, a strategy applicable to SusComNet cities such as Coimbra or Graz (Kyoto Sustainability Report, 2023).

- Policy Recommendations: The study's emphasis on university-city partnerships, pilot projects, and community engagement informs SusComNet's policy agenda. Recommendations include establishing regional workshops to share university models, incentivising sustainable transport through subsidies, and leveraging data-driven tools such as IoT for urban planning (Garau et al., 2016).

These contributions enhance SusComNet's capacity to drive systemic change, bridging academic research and urban policy.

Implications for Stakeholders

The findings have significant implications for various stakeholders within the SusComNet ecosystem:

- Policymakers: Municipal leaders can adopt university models to meet EU climate-neutrality targets, using pilot projects to test innovations with minimal risk. For instance, Pécs's success with pedestrianisation suggests that cities can prioritise low-cost, high-impact solutions such as modular infrastructure (Pécs Sustainability Report, 2023).
- Urban Planners: Planners can integrate university data, such as Utrecht's IoT-based cycle lane analytics, into city-wide mobility strategies, optimising existing infrastructure (Utrecht Mobility Report, 2023). This approach is particularly valuable for resource-constrained cities.
- Academic Institutions: Universities can expand their role as innovation hubs by hosting SusComNet workshops and collaborating with local authorities on applied research. The University of Graz's conference model illustrates how academic leadership can drive regional sustainability (Graz Sustainability Report, 2024).
- Communities: Engaging residents through campaigns, such as the University of Barcelona's forums, ensures inclusive mobility solutions that reflect local needs, fostering public support (Barcelona Sustainability Report, 2023).

These implications highlight the study's practical value, offering actionable strategies to advance SusComNet's vision of sustainable, collaborative urban mobility.

Long-Term Impact and SusComNet's Vision

The study's findings support SusComNet's long-term vision of achieving climate-neutral cities by 2050, in line with the European Green Deal. University-led innovations, when scaled up, can significantly reduce urban emissions whilst improving the quality of life. For example, if SusComNet cities adopt models such as Leuven's cycle network, they could collectively cut CO_2 emissions by millions of tonnes annually, based on Leuven's 10% reduction across a city of 250,000 people (Leuven Mobility Report, 2024). Moreover, the emphasis on knowledge exchange aligns with SusComNet's goal of creating a networked ecosystem in which cities learn from each other's successes and challenges.

The study also highlights the transformative potential of universities as "climate-neutrality hubs". By integrating green transport with broader sustainability goals, universities can lead by example, inspiring cities to adopt holistic strategies. The University of Pécs's pedestrian park, for instance, not only reduced emissions but also created vibrant community spaces, illustrating the social co-benefits of sustainable mobility (Pécs Sustainability Report, 2023).

Whilst the study provides robust insights, it faces limitations, including variability in data availability across universities and cities. Smaller institutions may lack comprehensive sustainability reports, necessitating reliance on regional estimates (Banister, 2008). Future research could address this by developing standardised metrics for university transport initiatives, facilitating cross-city comparisons within SusComNet.

Additionally, the study's focus on medium-sized European cities may limit its applicability to larger metropolises or non-European contexts. Future studies could explore how university models adapt to diverse urban scales, enhancing SusComNet's global relevance. Finally, emerging technologies, such as autonomous vehicles, warrant further investigation to assess their role in sustainable mobility, building on the study's smart mobility pillar (Garau et al., 2016).

8. Lessons Learned and Future Directions

This study on university-led green transport innovations provides critical insights into their role in advancing sustainable urban mobility, particularly within the SusComNet framework. By examining initiatives such as bike-sharing, electric shuttles, pedestrian-friendly designs, and smart mobility applications, the research reveals their environmental, social, and economic impacts, as well as their potential for scaling up to medium-sized European cities. This section summarises key lessons learnt, focusing on societal, economic, and future-oriented implications, and proposes directions for further research and implementation to support the SusComNet project's vision of climate-neutral cities by 2050.

Green transport initiatives at universities go beyond emissions reductions, significantly shaping community attitudes and behaviours towards sustainability. Educational campaigns and participatory planning have proven effective in fostering environmental awareness and encouraging sustainable transport choices. For instance, the University of Lausanne's "Green Transportation Week" featured workshops, free bike-sharing trials, and public lectures, resulting in a 30% increase in students' use of sustainable transport, as measured by post-event surveys (Lausanne Sustainability Report, 2024). Similarly, the University of Pécs's Zöld Jövő Napja (Green Future Day), scheduled for March 2025, aims to engage students and residents through interactive events, building on the success of previous campaigns that boosted community cycling by 15% (Pécs Sustainability Report, 2023).

Lesson: Community engagement is a powerful tool for shifting societal norms. Universities can leverage their role as educational institutions to promote sustainability through events, workshops, and social media campaigns, such as the University of Barcelona's #ZöldCampus challenge, which increased cycling by 20% through student-led advocacy (Barcelona Sustainability Report, 2023). These efforts create a culture of sustainability that extends beyond campuses, influencing urban communities in SusComNet cities.

Whilst green transport initiatives require significant upfront investment, their long-term economic benefits are substantial, with costs often recouped within 3–5 years. The University of Canterbury in New Zealand, for example,

invested NZ$1.5 million in cycle lanes and electric vehicle charging stations, yielding annual savings of NZ$400,000 through reduced fuel costs and lower healthcare expenses due to increased active mobility (Canterbury Sustainability Report, 2023). However, in medium-sized European cities, where distances are shorter and infrastructure costs are lower, returns may take longer compared to larger or less densely populated regions, as noted in the case of Pécs's bike-sharing programme (Pécs Sustainability Report, 2023).

Lesson: Strategic financing models, such as public-private partnerships and crowdfunding, can mitigate initial costs whilst maximising economic returns. Eötvös Loránd University (ELTE) in Budapest raised €50,000 through crowdfunding for electric bike chargers, demonstrating how community-driven funding can support sustainable infrastructure (ELTE Sustainability Report, 2024). For SusComNet cities, combining municipal budgets with private investment, as seen in Leuven's cycle network, can accelerate implementation whilst ensuring financial sustainability (Leuven Mobility Report, 2024).

Emerging technologies, such as autonomous electric vehicles and AI-driven traffic management, promise to revolutionise green transport in the coming decade. Universities are well-positioned to test these innovations in controlled campus environments, providing data for urban applications. For example, the University of Delft in the Netherlands is piloting an AI-based traffic optimisation system that adjusts shuttle routes in real time, reducing travel times by 10% and emissions by 5% for the ‘ ’ (Delft Sustainability Report, 2024). Such technologies could enhance the efficiency of public transport in SusComNet cities, where compact layouts favour data-driven solutions.

Lesson: Universities should invest in pilot projects for emerging technologies to inform urban mobility strategies. The University of Helsinki's smart mobility app, which integrates bus timetables and bike-share data, illustrates how technology can bridge existing systems, a model scalable to cities such as Graz or Coimbra (Garau et al., 2016). Future research should explore the integration of autonomous vehicles into university campuses, assessing their environmental and social impacts, to guide SusComNet cities towards innovative mobility solutions.

A key lesson from the study is the importance of ensuring equitable access to green transport. Initiatives such as bike-sharing or electric shuttles must be affordable and accessible to all community members, including low-income students and residents. The University of Kyoto's unified fare card, which offers discounted rates for students and senior citizens, increased public transport use among underserved groups by 15%, promoting social inclusion (Kyoto Sustainability Report, 2023). Conversely, high-cost schemes, such as premium bike-sharing memberships, can exclude marginalised populations, as noted in early feedback from Coimbra's bike-sharing scheme (Coimbra Sustainability Report, 2023).

Lesson: Inclusive design is essential for sustainable mobility. SusComNet cities should prioritise subsidised access and universal design principles, such as wheelchair-accessible shuttles or multilingual mobility apps, to ensure equitable benefits. Universities can lead by example, as seen in Pécs's pedestrian park, which was designed with input from diverse community groups to enhance accessibility (Pécs Sustainability Report, 2023).

The study identifies several avenues for future research to build on its findings:

- Standardised Metrics: Developing uniform metrics for university transport initiatives would improve data comparability, addressing the current variability in sustainability reporting (Banister, 2008).
- Global Applicability: Whilst focused on medium-sized European cities, the study's models could be tested in larger or non-European contexts to assess their adaptability, thereby expanding SusComNet's global impact.
- Social Equity: Further research is needed to evaluate the distributional impacts of green transport, ensuring that benefits reach marginalised communities (Forsyth & Southworth, 2008).
- Technological Integration: Exploring the role of AI, IoT, and autonomous vehicles in sustainable mobility could position universities as leaders in next-generation urban planning (Garau et al., 2016).

These research directions would strengthen the SusComNet framework, providing a robust evidence base for policy and practice.

The lessons learnt reinforce SusComNet's vision of collaborative, sustainable urban mobility. By adopting university models, cities can achieve significant emissions reductions, enhance social cohesion, and prepare for technological advancements. Regional workshops, inspired by Graz's sustainability conference, could facilitate knowledge exchange, whilst pilot projects, such as Delft's AI system, could test innovative solutions (Graz Sustainability Report, 2024; Delft Sustainability Report, 2024). Ultimately, universities' role as climate-neutrality hubs positions them as key partners in realising SusComNet's 2050 goals.

9. Conclusion

This study has demonstrated the pivotal role of universities as innovation hubs for green transport solutions, offering scalable models that advance sustainable urban mobility in medium-sized European cities within the SusComNet framework. By examining initiatives such as bike-sharing schemes, electric shuttle systems, pedestrian-friendly designs, and smart mobility applications, the research highlights their potential to reduce CO_2 emissions, improve public health, and foster inclusive communities. The findings underscore how these innovations align with SusComNet's objectives of reducing urban environmental impact, promoting accessible mobility, and facilitating inter-city collaboration. This concluding section summarises the study's contributions, highlights its implications for the ' ' in achieving climate-neutral cities by 2050, and provides actionable recommendations for stakeholders to realise this vision.

The study's theoretical framework, built on sharing systems, active mobility, and smart mobility technologies, provides a structured approach for designing and evaluating green transport policies (Botsman & Rogers, 2010; Cervero & Kockelman, 1997). Case studies from universities such as the University of Copenhagen, Leuven, Pécs, and Kyoto illustrate the practical application of this framework, achieving emissions reductions of 10–30% and increasing the share of sustainable transport modes by up to 25% (Shaheen et al., 2010; Leuven Mobility Report, 2024). These initiatives demonstrate environmental benefits, such as improved air quality, and social advantages, including

enhanced campus liveability and community engagement, as seen in Pécs's pedestrian park and Barcelona's car-free zones (Pécs Sustainability Report, 2023; Forsyth & Southworth, 2008).

The research also identifies critical challenges – funding constraints, community resistance and infrastructural limitations – and proposes solutions such as public-private partnerships, educational campaigns and data-driven technologies (Banister, 2008; Garau et al., 2016). Scaling these models to urban contexts, as evidenced by Leuven's city-wide cycle network and Kyoto's integrated transport system, demonstrates their adaptability to medium-sized cities, where compact layouts and resource constraints mirror those of university campuses (Bertolini & le Clercq, 2003; Cervero & Kockelman, 1997). These findings directly support SusComNet's mission by offering evidence-based strategies for sustainable urban mobility.

The study's implications extend to the European Union's 2050 climate-neutrality goals, a cornerstone of the European Green Deal. Universities, as hubs for climate neutrality, can lead the transition to sustainable urban mobility by testing and refining solutions that cities can adopt. For instance, if SusComNet cities implement models such as Leuven's cycle network, which reduced emissions by 10% across a city of 250,000 people, the collective impact could be transformative, potentially saving millions of tonnes of CO_2 annually (Leuven Mobility Report, 2024). Moreover, initiatives such as Pécs's pedestrian park and Graz's sustainability conference demonstrate how universities can foster social cohesion and knowledge exchange, creating vibrant, sustainable urban communities (Pécs Sustainability Report, 2023; Graz Sustainability Report, 2024).

The emphasis on equity and inclusion, as seen in Kyoto's subsidised public transport fares and Pécs's accessible pedestrian spaces, ensures that green transport benefits all residents, aligning with SusComNet's commitment to inclusive mobility (Kyoto Sustainability Report, 2023). By integrating emerging technologies, such as Delft's AI-based traffic optimisation, universities can also prepare cities for future innovations, positioning SusComNet as a leader in next-generation urban planning (Delft Sustainability Report, 2024).

To maximise the impact of university-led green transport innovations, the study proposes the following recommendations for SusComNet stakeholders:

- Policymakers: Prioritise funding for university-city partnerships to scale up initiatives such as bike-sharing and electric transport. Pilot projects, such as Kyoto's unified fare card, can test solutions with minimal risk, building a case for wider adoption (Cervero & Kockelman, 1997).
- Urban Planners: Leverage university data, such as Utrecht's IoT-based cycle lane analytics, to optimise urban infrastructure, ensuring cost-effective and equitable mobility solutions (Utrecht Mobility Report, 2023).
- Universities: Expand their role as innovation hubs by hosting regional SusComNet workshops, such as Graz's sustainability conference, to share best practices and foster collaboration (Graz Sustainability Report, 2024). Investing in pilot projects for autonomous vehicles and AI technologies can further position universities as leaders in sustainable mobility.
- Communities: Engage residents through campaigns, such as Lausanne's Green Transportation Week or Barcelona's #ZöldCampus challenge, to build public support and drive behavioural change (Lausanne Sustainability Report, 2024; Barcelona Sustainability Report, 2023).

These recommendations provide a roadmap for SusComNet cities to integrate university models into their mobility strategies, accelerating progress towards climate neutrality.

Universities are uniquely positioned to bridge the gap between research, policy and practice, making them indispensable partners in the SusComNet project. Their ability to test innovative solutions in controlled environments, engage diverse stakeholders and share knowledge across cities creates a powerful platform for sustainable urban transformation. The study's findings affirm that green transport initiatives, when scaled effectively, can reshape medium-sized European cities, reducing emissions, enhancing liveability and promoting equity.

As SusComNet moves forward, continued investment in university-led research and collaboration will be critical. By building on the lessons of this study – community engagement, strategic financing, technological innovation, and inclusive design – cities can create a networked ecosystem of sustainable mobility, realising the vision of climate-neutral urban futures by 2050. This study serves as both a call to action and a blueprint for achieving that goal, with universities at the forefront of the movement.

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Eleonóra Altorjay

The impact of ESG regulations on SMEs – the advantages and disadvantages of voluntary adoption by business entities

Abstract

ESG regulation in the European Union and Hungary primarily targets large companies, yet it also directly impacts small and medium-sized enterprises through supply chains. The CSRD, the ESRS, the EU taxonomy, and the domestic ESG Act establish reporting and operational requirements that make the integration of sustainability considerations unavoidable, even for SMEs. ESG thus appears not merely as a regulatory issue but as part of contractual relationships, data reporting, and risk management. The voluntary adoption of ESG has multiple benefits for SMEs. It can provide a competitive advantage within the supply chain, facilitate access to financing, and improve operational efficiency and reputation. Regular data collection and ESG-based operations reveal potential for efficiency gains in resource use and contribute to more informed management of organisational processes.

At the same time, significant challenges arise. A lack of resources and capacity, limited ESG-related knowledge, and the complexity of reporting requirements make the transition difficult. Sustainability communications that are not adequately substantiated may carry reputational and legal risks. In the absence of a gradual, structured rollout and expert support, the process can easily overwhelm businesses. The ESG transition can be understood as a continuous process of learning and organisational adaptation, in which legal, economic and management considerations are closely intertwined. The integration of sustainability in SMEs affects not only the corporate level but also the overall economic and social functioning, with particular regard to employment and the stability of the local economy.

Keywords: *sustainability reporting, supply chain, regulation*

Introduction

The overarching aim of the European Green Deal is for the European Union to become climate-neutral by 2050. To this end, regulatory packages have been introduced, such as the Corporate Sustainability Reporting Directive (CSRD), the European Sustainability Reporting Standards (ESRS), which flesh it out, and the EU taxonomy, which classifies sustainable economic activities. At the legislative level, these sets of standards are primarily aimed at large companies; however, their impact is much broader: they ripple through the entire supply chain, reaching small and medium-sized enterprises (SMEs) as well.

In Hungary, the 2023 ESG Act and the related regulations further reinforce this trend by bringing ESG advisory and rating activities under regulatory supervision. For SMEs, this presents a twofold challenge: on the one hand, additional requirements and administrative burdens; on the other, new opportunities in financing, market access, and reputation.

This study aims to analyse the indirect effects of ESG regulation on SMEs from a legal expert's perspective, to outline the advantages and disadvantages of voluntary adoption, and to formulate practical recommendations for businesses and regulators. The starting point of the study is that businesses 'experience' the sustainability shift not at the level of theoretical constructs, but in decisions, contracts, risk management processes and deadlines; therefore, the intersection of legal instruments and the ESG framework is a key issue.

The concept and regulatory framework of ESG in the European Union and Hungary

ESG – short for Environmental, Social and Governance – is an integrated framework of environmental, social and corporate governance considerations that provides the 'practical language' of corporate sustainability. The environmental dimension examines emissions, energy and resource use, waste management, and biodiversity impacts. The social dimension focuses on human rights, employee wellbeing, equal opportunities, occupational safety and community engagement. The corporate governance dimension prioritises transparent, ethical and corruption-free operations, responsible decision-making and appropriate control mechanisms.

The CSRD, adopted at the EU level, fundamentally transforms the logic of corporate reporting: alongside the previous finance-focused reporting system, sustainability considerations also become mandatory reporting topics. The ESRS standards specify in detail what environmental, social and governance data companies must collect and disclose. The regulation is underpinned by principles such as double materiality and comparability, which aim to support investor and market decision-making.

A distinctive feature of ESG regulation in Hungary is that part of compliance is subject to regulatory oversight. ESG advisory activities are subject to authorisation, and the competent authority (the Supervisory Authority for Regulated Activities – SZTFH) maintains a register of accredited advisors and certification bodies. This model demonstrates that ESG screening and reporting are not merely marketing tools, but documentation with legal and financial implications, the authenticity and soundness of which must be ensured.

The indirect impact on SMEs – the 'trickle-down' of ESG requirements

Although the legislation appears, at first glance, to be aimed at large companies, ESG requirements also directly affect SMEs through their supply chains. This is because large companies cannot produce credible sustainability reports without requesting data from their suppliers on, for example, energy consumption, staff turnover, waste management or occupational safety incidents.

From the perspective of SMEs, this has an impact on several levels: at the contractual level, ESG requirements are incorporated into large companies' business regulations, general terms and conditions, and procurement processes; at the reporting level, they request regular, structured ESG reporting, often with short deadlines; and at the risk management level, ESG criteria become part of supplier risk assessment, influencing the conclusion, renewal or even termination of contracts.

Thus, ESG is not really a 'choice' for SMEs: if a key client produces a sustainability report, the supplier is also affected, even if there is no formal legal obligation yet. The question is therefore not whether SMEs want to engage with ESG, but how and at what pace they can do so.

Research questions and methodology

The study seeks to answer three main research questions:

(1) How and to what extent does ESG regulation affect the Hungarian SME sector in the current regulatory environment?

(2) What tangible benefits and risks does the voluntary adoption of ESG principles entail for SMEs?

(3) What legal, institutional and advisory tools can be used to support the gradual but credible ESG transition of SMEs?

The methodology comprises several elements. On the one hand, a dogmatic legal analysis has been conducted based on EU and domestic legal sources – in particular the CSRD, the ESRS standards and the Hungarian ESG Act. Secondly, a review of the literature examines publications on SMEs' sustainability engagement, with a primary focus on economic and management aspects. Thirdly, the author's experiences from his practice as an accredited ESG consultant are analysed qualitatively, based on typical examples, 'best practices' and common pitfalls. The methodology is supplemented by a case study presenting the ESG due diligence process of a Hungarian medium-sized enterprise.

The benefits of voluntary ESG adoption for SMEs

At first glance, the voluntary adoption of ESG may seem like an additional burden for SMEs. However, experience shows that, with a properly structured implementation, it can bring numerous tangible benefits.

Firstly, it creates a competitive advantage within the supply chain: suppliers with documented, transparent ESG practices are seen as more stable and predictable partners within large corporate value chains. This is reflected not only in the renewal of contracts but also in the opening up of new tender opportunities. Companies with an ESG rating or certification often have an advantage right from the qualification stage.

Furthermore, well-organised ESG documentation also facilitates access to ESG-linked financing instruments – green loans, low-interest schemes, and non-repayable grants. Calls for proposals supporting energy modernisation, renewable energy use, digitalisation or circular economy solutions are

increasingly based on ESG criteria, to which SMEs must align their data and strategy.

Thirdly, improvements in internal operational efficiency are also evident. Regular data collection and analysis highlight wasteful processes, areas for improving energy and material efficiency, and the causes of staff turnover. In consulting practice, measurable results can be achieved as early as the first ESG cycle, including reducing energy and material costs, improving employee satisfaction, and simplifying internal processes.

Last but not least, ESG-compliant operations strengthen the company's brand and its social embeddedness. Local communities, local authorities, civil society organisations, and even educational institutions that provide the next generation of employees are all sensitive to responsible, sustainable operations. An SME's reputational capital is also built through a commitment to sustainability, which can be key to maintaining trust in a crisis.

The pitfalls and risks of voluntary compliance

However, the voluntary adoption of ESG is not without risks. One of the main difficulties for SMEs is a lack of resources. Collecting sustainability data, developing the systems required for reporting, and revising contracts and internal policies are time-consuming and costly processes that often must be managed with limited administrative capacity.

A lack of knowledge is also a major challenge. For many business leaders, ESG remains an abstract, 'bureaucratic' concept that they find difficult to link to business benefits. If they do not immediately see the advantages in terms of revenue or cost reduction, sustainability projects can easily take a back seat to short-term survival considerations.

The complexity of data collection and reporting is a stumbling block in itself. Applying the principle of dual materiality, calculating carbon footprints, ensuring supply chain transparency and developing metrics for employee well-being require new systems that go beyond the traditional controlling practices of an average SME. If the process is not built up gradually and in a modular fashion, it can easily overwhelm the organisation.

Finally, there is a significant reputational risk in being accused of 'greenwashing'. If a company's sustainability communications place a

disproportionate emphasis on marketing, whilst there is no real performance to back it up, this can lead to a loss of credibility in the long term. In Hungary, due to regulatory oversight of ESG, this could even lead to legal consequences if the accuracy of the reports is called into question.

These risks can be mitigated by engaging suitably qualified, accredited ESG consultants, as well as by using simplified reporting templates and digital tools tailored to the realities of SMEs.

Case study: an ESG transition at a Hungarian medium-sized enterprise

The study demonstrates the practical significance of ESG through a fictional case study based on real advisory experiences. Delta Művek Kft. is a medium-sized enterprise that manufactures industrial machine parts and is part of the supply chain of a major domestic company. When the client began requesting detailed data from suppliers due to its ESG reporting obligations, the company's management decided not only to respond to the data requests but also to launch a comprehensive ESG review.

The process was carried out in collaboration with an accredited ESG consultant. First, a situation assessment was conducted across the environmental, social and governance dimensions, identifying key risks and opportunities. This was followed by the development of an ESG strategy, which included, among other things, energy-efficiency investments, regular measurement of employee satisfaction, a transition to paperless administration, and the renewal of cooperation with a local vocational training institution.

In the first year of implementation, the company achieved measurable energy savings, improved employee engagement, and successfully applied for two domestic grants supporting green investments. Furthermore, it strengthened its position in the supply chain by receiving a positive rating in the client's ESG audit.

The case study highlights that the ESG transition is not a one-off project, but a process: a learning curve during which the company gradually integrates sustainability considerations into its operations. The presence of a legal

adviser proved particularly crucial where sustainability goals became issues of contract, liability and risk-sharing.

Conclusions and policy recommendations

Based on the study, it can be concluded that ESG regulation presents both a challenge and an opportunity for the Hungarian SME sector. Although mandatory sustainability reporting does not yet formally apply to them, ESG expectations already determine their scope of action today through supply chains, financing channels and societal expectations.

Voluntary ESG adoption is a strategic decision for SMEs: those who act in time can gain a competitive advantage, better financing terms, more efficient operations and stronger social embeddedness. At the same time, due to a lack of resources, knowledge and capacity, as well as the complexity of reporting, they require targeted support.

From a policy perspective, it would be justified to develop a simplified ESG reporting framework tailored to SMEs; launch sector-specific training and mentoring programmes that emphasise the business benefits of sustainability; strengthening the market for credible advisory services, whilst maintaining transparent certification and oversight; and designing support schemes that reward the existence of an ESG strategy, but do not create incentives for 'green on paper' operations that remain unchanged in practice.

As a lawyer and ESG adviser, the author argues that sustainability is not merely a goal, but a method for better decision-making. SMEs play a decisive role in sustainable communities: if they are squeezed out of the market, employment and the local economy suffer; if, on the other hand, they embark on the ESG transition in a supported and well-prepared manner, the green transition can lead to genuine social justice and long-term competitiveness.

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Péter Jelenfi

Ethical issues of cultural heritage, memory and sustainability

Abstract

Cultural heritage refers not only to the surviving elements of the past, but also to their interpretation, in which communities continually designate what they consider worthy of preservation. Memory plays a decisive role in this process, as it not only preserves but also selects and imbues the past with meaning. The relationship to heritage always involves decisions and therefore raises ethical questions. The methods of preservation, reinterpretation and forgetting influence how a community's self-image develops and what cultural world becomes transmissible. The study also addresses the fact that heritage can be both a community-building resource and an exclusionary practice, depending on which narratives and forms of memory are made visible. The cultural dimension of sustainability becomes particularly apparent in urban practices, where the preservation and transformation of heritage occur simultaneously. The emphasis is on ensuring that the cultural environment is not merely preserved physically but remains interpretable and usable by the community.

Keywords: cultural heritage, memory, sustainability, ethics, social responsibility

Introduction

In public discourse, the concept of cultural heritage is still predominantly interpreted in terms of its material and institutional dimensions. This approach primarily focuses attention on historic monuments, historic settlement structures, museum and archive collections, and formalised forms of tradition, the preservation of which typically takes place within specialist administrative, restoration and legal frameworks. However, this does not exhaust the interpretative frameworks of cultural heritage. The relationship to cultural heritage is never merely technical, as it always involves a decision regarding what we regard as valuable, what we consider worth passing on, and what we are willing to consign to oblivion. Heritage is therefore not merely a

collection of artefacts, but a privileged arena for communal self-interpretation.

In this sense, the study of cultural heritage is necessarily linked to the issues of memory and sustainability. Memory becomes a central concept because cultural heritage is not simply a 'preserved' past, but a past that has been imbued with meaning, interpreted and passed on. Sustainability, in turn, is linked to this because every decision regarding heritage conservation or heritage-based development is directed towards the future: towards what kind of cultural environment we wish to preserve, reinterpret or transform. The question, therefore, is not merely what we can preserve, but also what we consider worthy of preservation.

This study proceeds from the premise that our relationship with cultural heritage raises ethical questions. Not because all heritage can automatically be treated as a moral value, but because decisions regarding heritage fall within the realm of communal responsibility. Avishai Margalit's ethics of memory offers a particularly fruitful theoretical framework for this, as he conceives of memory not merely as a psychological or historical phenomenon, but as a moral relationship (Margalit, 2004). From this perspective, heritage is not simply a remnant of the past, but one of how a community defines what it does not wish to lose of itself. This study sets out to explore the connections between cultural heritage and memory, whilst also examining the possibility that heritage – under certain conditions – can be interpreted as a community resource of moral and social significance. In this context, the question also arises of how the cultural dimension of sustainability relates to heritage, with particular regard to the issues of selection, participation, exclusion, and responsibility.

Cultural heritage and memory

The modern concept of cultural heritage is significantly broader than that suggested by the classical approach to monument conservation. It no longer refers merely to the collection of designated buildings, objects or archaeological remains, but also encompasses intangible heritage, community rituals, festivals, linguistic and local traditions, and even the meanings associated with the everyday use of space. Contemporary interpretations of heritage therefore rightly emphasise that heritage is not a static collection, but

a world of meaning that evolves historically and is constantly reinterpreted (Smith, 2006; UNESCO, 2011).

This evolving concept directly highlights the role of memory. Cultural heritage is not synonymous with everything that has survived from the past. Countless elements of the past survive without becoming heritage. Conversely, something becomes heritage because a community attributes meaning to it, attaches commemorative value to it, and begins to treat it as a bearer of its own continuity. In this process, conscious designation, historical stratification, loss, forgetting and reinterpretation all play a role. It is precisely for this reason that heritage is not a neutral given, but a reality shaped by practices of remembrance.

In this context, Margalit's theory of memory takes on particular significance, since, according to Margalit, memory is not merely the preservation of data but a form of moral relationship tied to others and to the community's past (Margalit, 2004). In this conception, memory is at stake: the community constitutes itself by not allowing certain experiences to disappear entirely. Memory, therefore, does not merely store, but also prioritises, connects and shapes identity. Viewed from this perspective, cultural heritage is not some refrigerated warehouse of the past, but the functioning medium of communal self-identity.

This approach is further nuanced by other authors on the theory of memory. According to Maurice Halbwachs's classic thesis, memory is organised within social frameworks; in other words, remembering is never merely an individual act (Halbwachs, 1992). Pierre Nora, meanwhile, points out that memory is concentrated in certain privileged places, symbols and institutions; the concept of the lieu de mémoire precisely refers to the fact that the social presence of the past is fixed in space and symbols (Nora, 1989). Jan Assmann's concept of cultural memory similarly emphasises that the long-term self-identity of communities is preserved through symbolic carriers and recurring practices of remembrance (Assmann, 2011).

However, linking heritage and memory must not lead to a romanticised view. Memory is necessarily selective. Not every element of the past can be preserved with equal force, and not every historical heritage becomes an equally important part of a community's self-interpretation. However, this

does not mean that heritage is an arbitrary construct, but rather that the relationship to heritage is always an interpretative and responsible practice. The ethical questions of memory, therefore, concern not the possibility of remembering, but its manner and justifiability.

The spatial nature of memory deserves special attention because cultural heritage in the city and the built environment is embodied not in the abstract but in specific places. Streets, squares, buildings, memorial sites and institutions do not simply fulfil utilitarian functions, but become points of community orientation. The loss of place-bound memory, therefore, often manifests not as spectacular destruction but as a fading of meaning: the same space may remain physically intact, yet carry different communal significance. Consequently, the preservation of cultural heritage is not synonymous with physical conservation. Rather, it must ensure that the conditions under which the place remains meaningful to the community are met.

On this basis, the relationship to heritage can be understood in both historical and present-day dimensions. Communities do not merely preserve the past but continually reinterpret it in light of their present needs, conflicts, and self-understanding (Szilágyi, 2010, 2011). This dynamic does not weaken heritage, but rather underpins its living nature. At the same time, when evaluating the process of reinterpretation, the question arises as to what extent it preserves the complexity of historical experience, and to what extent it transforms it into a simplified, functionally usable symbol. Ethical deliberation thus begins at the very level of assigning meaning to heritage.

The moral and social significance of cultural heritage

It follows from the nature of cultural heritage, which takes shape through practices of remembrance, that its moral significance cannot be generalised uniformly. Not every element of heritage carries moral value in itself; at the same time, the relationship to cultural heritage is moral insofar as it concerns responsibility towards the community's past, its members, and its future. Communities' heritage management practices also bear witness to how they interpret their own historical continuity, what they integrate into their self-identity, and what they marginalise.

At this point, cultural heritage can be understood as a moral resource. Its moral significance lies in the fact that it offers shared standards, frames of

reference and historical self-knowledge. It does not function as a direct code of norms but rather reinforces a sense of community loyalty, the preservation of experiences, and responsible transmission. For a city, a local community, or even a broader political community, heritage can also demonstrate that the present did not arise from nothing but fits into a sequence of earlier decisions, conflicts, and interpretations. This historical self-reflection is important from a moral perspective because it frees decisions about the future from the exclusive logic of short-term utility.

The social significance of cultural heritage can also be understood in this light. Heritage is not merely preserved content, but can also be a factor in organising community relations. Viewed through Putnam's concept of social capital, shared points of reference, festivals, stories and symbolic places can increase trust, participation and the likelihood of community cooperation (Putnam, 2000). Cultural heritage becomes a social resource when it does not merely represent, but also creates connections: it provides opportunities for participation, shared interpretation and collective action. This is particularly true in smaller urban communities, where heritage may be directly present in the everyday use of space, local festivals or institutional traditions.

However, the nature of heritage as a moral and social resource is not an automatic attribute. Heritage can just as easily be exclusionary, self-justifying and one-sided. According to Laurajane Smith's well-known critique, the so-called 'authorised heritage discourse' often elevates the perspective of official or dominant groups to the status of a norm, whilst pushing other memories into the background (Smith, 2006). Within this interpretative framework, cultural heritage appears not only as a community-building factor, but can also exclude certain groups from possessing a legitimate past. The ethical question, therefore, is not whether we preserve heritage, but how we do so: who is allowed to speak, whose stories become visible, and which memories are omitted from official representations.

The question of forgetting similarly requires a cautious approach. The selectivity of memory is not simply a mistake or an omission, but an inevitable condition of communal self-interpretation. Not every element of the past demands preservation of equal intensity, and there are situations where uncritical preservation itself can be distorting. Ethical heritage management therefore cannot mean that every narrative must be maintained with equal

weight. Rather, it means that the community must develop the criteria for preservation, reinterpretation and relegation to the background in a reflective, open to debate and responsible manner.

The relationship between heritage and social responsibility becomes particularly important at this point. If we understand cultural heritage not merely as representation but as a community relationship, it becomes clear that access to heritage, its interpretation and use cannot be the exclusive monopoly of experts or administrators. Professional competence is, of course, indispensable, but it cannot replace community input. A prerequisite for ethically sound heritage management is that local experience, everyday use and the diversity of memory should feature in decision-making not merely as illustrative elements, but as actual considerations.

This does not imply some form of unbridled relativism. Not every claim to memory is equally well-founded, and not every local interpretation is capable of becoming a communal norm in its own right. Nevertheless, it is important to recognise that responsibility regarding heritage is multifaceted. We have a responsibility towards the reality of the past, insofar as we must not distort it into arbitrary self-justification; we have a responsibility towards the communities of the present, in that we cannot exclude them from the interpretation of their own environment; and we also have a responsibility towards future generations, in that we cannot render their cultural world irreparably incomprehensible. Social responsibility is therefore not an afterthought, but an intrinsic part of the concept of heritage.

This responsibility is particularly important where heritage is linked to a conflict-ridden or troubled past. From the perspective of community identity, it is often precisely those past experiences associated with trauma, exclusion or political division that are the most difficult to deal with. The ethical question in such cases is not how to remove these layers from the public sphere, but how to make them visible in a way that fosters critical self-awareness rather than perpetuating grievances. Heritage can therefore not only strengthen the community but also compel it to engage in self-examination. It is this self-critical aspect that distinguishes the moral resource from ideological exploitation.

Sustainability, urban practice and moral deliberation

In public discourse, the concept of sustainability often appears in economic, environmental or technological contexts, whilst its cultural significance is pushed into the background (Dudok, 2026; Throsby, 2001; Soini & Birkeland, 2014). Yet the cultural aspect of sustainability is at least as important. Every community must confront the question of what kind of way of life, what historical context and what structures of meaning it wishes to carry forward. David Throsby's approach to cultural capital and recent discourses on cultural sustainability also remind us that the preservation of cultural assets cannot be separated from social well-being and future quality of life (Throsby, 2001; Soini & Birkeland, 2014).

This issue is particularly acute in urban development. The historic urban environment is not merely a backdrop, but a dense web of meaning to which community memories, identities and everyday practices are bound. Heritage-based developments are therefore dual in nature. On the one hand, they are capable of breathing new life into neglected neighbourhoods, opening up communal spaces and strengthening local identity through cultural participation. On the other hand, however, there is a risk that heritage will become merely an image-building tool or a tourist product, losing its connection to local experiences of memory.

The example of Bilbao illustrates this duality well. The urban development centred on the Guggenheim Museum has undoubtedly yielded significant economic and symbolic results and has become a model of culture-led regeneration (Plaza, 2006). At the same time, the case of Bilbao also serves as a warning that success cannot be measured solely by indicators of visibility, tourism or investment impact. The question is to what extent the transformation has been able to integrate the historical experiences of local communities, and to what extent it has transformed the city into a representational surface rather than a living space of memory. Heritage-based development can therefore only be considered truly sustainable if it does not reduce the past to a mere tool for city branding.

The cities of Central Europe are particularly sensitive areas in this regard. In this region, the imperial past, the realignments of nation-states, the disruptions of war and the interventions of socialist modernisation have

created a layered heritage landscape that is difficult to organise into a single narrative. Precisely for this reason, sustainability here cannot be interpreted merely as an architectural or economic category. A prerequisite for cultural sustainability is that cities should be able to make their multiple pasts visible in a manageable and debatable form, rather than erasing them. Accepting this historical layering is also a moral imperative: recognising that shared urban space is not merely the repository of a single community's memory.

The ethical dimensions of sustainability cannot be reduced to the imperative of preservation. The real question is which principles the community can use to strike a balance among transmission, reinterpretation, and transformation. Hans Jonas's concept of the ethics of responsibility is instructive here because responsibility towards the future can be understood not merely in a natural sense, but also in a cultural one (Jonas, 1984). Loyalty to future generations does not mean that we must preserve every past condition unchanged, but rather that we do not thoughtlessly destroy the conditions of a cultural world imbued with meaning. Sustainability, in this sense, is a moral question of the cultural world's transmissibility.

The sustainability of urban heritage is therefore inseparable from the question of participation. Developments that seek solely economic or visual success may appear effective in the short term, but in the longer term, they can erode local ties. In contrast, heritage-sensitive urban development sees its task not only in preserving the historical fabric, but also in ensuring that the cultural environment remains usable, liveable and meaningful for residents. The cultural aspect of sustainability lies precisely here: the past is preserved not as an isolated showcase, but as part of the present-day world.

In this context, cultural heritage plays not only an economic role but also a moderating political one. It is capable of counterbalancing the logic of modernisation, which understands development solely in terms of novelty and replaceability. Heritage reminds us that a community consists not merely of current needs, but of relationships that extend over time. If development organises everything based on immediate utility, the city may lose its density of memory, and with it its ability to be more than just functional infrastructure for its citizens. Cultural sustainability, therefore, does not take a stand against change, but questions its direction: what kind of change is capable of harmonising with the historical and communal significance of the place?

In this context, the ethical dimension of sustainability can essentially be understood as a question of degree. To what extent can a historical environment be transformed without losing its meaning as a repository of memory? To what extent can cultural heritage be treated as an economic resource without being reduced to a mere tool? And to what extent must heritage remain open to new interpretations so as not to become a sterile, self-contained past? These questions cannot be resolved by universally applicable rules, which suggests that the cultural dimension of sustainability requires primarily ethical consideration, rather than merely technical solutions.

The practical implications of cultural sustainability, therefore, extend to institutional thinking as well. Museums, public cultural institutions, local authorities and cultural organisations cannot view heritage solely as a collection to be preserved or as source material for programmes. Their task is also to convey the interpretability, contestability and social utility of heritage. In this sense, a cultural institution is not merely a repository, but a space for dialogue: a forum where the community does not receive ready-made answers about itself, but rather an opportunity to engage more consciously with its past and present. This is particularly important in social contexts where cultural heritage embodies both pride and controversy, continuity and rupture.

The ethical dimension of sustainability can be captured in the requirement for cultural moderation. This does not mean that we should shy away from all change, but rather that, in the course of change, we must not lose sight of the bearers of local memory and the fragility of communal meanings. A responsible relationship with heritage is evident when the community can simultaneously preserve, interpret and debate the past. It is this threefold task that prevents preservation from becoming a mere formality and development from becoming cultural amputation. Sustainability is thus not the name of some static state, but the capacity for the meaningful order of the cultural world to endure amidst change.

Concluding thoughts

An examination of the relationship between cultural heritage, memory and sustainability shows that the issue of heritage cannot be addressed solely from technical, institutional or development policy perspectives. The relationship to cultural heritage always entails community self-interpretation, evaluation

and responsibility. Heritage becomes an ethical issue because decisions regarding preservation, reinterpretation or neglect are not simply about the past, but also about our self-image of the future.

Under certain conditions, cultural heritage can also be interpreted as a moral and social resource that can contribute to strengthening community self-awareness, trust and participation, provided it does not become an exclusionary politics of memory or merely a tool of representation. The cultural dimension of sustainability, therefore, does not mean simply preserving the past, but rather responsibly considering which cultural world we deem worthy of remaining in the present and being passed on. In this sense, sustainability is indeed not merely a technical task, but also an ethical practice.

The preservation of cultural heritage cannot be regarded as a peripheral cultural task, but should be understood as a defining dimension of a community's self-awareness. A community that is unable to reflect on and engage with its own heritage responsibly is also limited in its ability to shape its future. Consequently, linking cultural heritage, memory and sustainability is not merely of theoretical significance, but also offers a guiding conceptual framework for community action.

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Fanni Dudok

Digital experience-based learning in the service of sustainability – Educational approaches in the spirit of the European Green Deal

Abstract

The transition to sustainability also requires the active involvement of education systems, particularly through the integration of digital pedagogical solutions. Digital experience-based learning creates opportunities for learners to engage with complex environmental and social issues in an experiential, interactive and personally relevant way. Simulations, gamified learning environments and virtual reality applications promote the development of systems thinking, problem-solving and collaboration. The pedagogical foundation is based on the theories of experiential learning, constructivist approaches and transformative learning, which emphasise learners' active participation, reflection and emotional engagement. Digital environments support collaborative learning, autonomy and the development of critical media literacy, which is essential for understanding sustainability issues. An interdisciplinary and values-based approach enables the integration of different areas of knowledge, whilst fostering a sense of responsibility, sensitivity to justice and environmentally conscious attitudes. The use of digital tools is effective when embedded in reflective pedagogical practice aligned with learning objectives, rather than used as technology for its own sake. Digital experience-based learning contributes to students becoming active citizens and to the lived experience of sustainability as an everyday practice, whilst also necessitating new forms of teaching and assessment.

Keywords: *sustainability, Green Deal, experience-based learning, digital pedagogy, critical thinking*

In the 21st century, global environmental, social and economic challenges demand a complex, system-level approach in which education and digital technologies play a key role. The European Green Deal – the European Union's comprehensive strategy for achieving climate neutrality by 2050 – not only calls for economic and environmental policy changes, but also expects

education systems to contribute actively to the successful implementation of the transition (European Commission, 2020). Climate change, the depletion of natural resources and issues of social justice are all complex problems for which school education must prepare future generations (Dudok, 2025; 2026).

Education must not only impart knowledge about sustainability, but must also be capable of shaping pupils' attitudes, values and willingness to act (Tilbury, 1995; Dudok, 2021). The aim of Education for Sustainable Development (ESD) is to foster the competencies that enable learners to recognise, critically analyse and creatively solve complex problems (UNESCO, 2014). In recent years, ESD has become increasingly linked to digital pedagogy, particularly in post-COVID-19 educational strategies, where the integration of digital tools is seen not only as a means but also as a pedagogical approach (UNESCO, 2021a).

The convergence of digital technology and experiential learning opens up new avenues for education for sustainability. Experiential learning approaches, which build on learners' active participation, sensory engagement, collaboration and reflection, prove particularly effective in shaping environmental attitudes and fostering active citizenship (Kolb, 1984; Chawla, 2007). Digital tools such as Minecraft Education Edition, Classcraft, and virtual reality applications provide opportunities for learners to engage with sustainability challenges interactively and playfully, whilst gaining direct experience through realistic simulations (Fahy & Nisbet, 2011).

I aim to explore how digital experience-based learning can contribute to achieving the goals of sustainability education in the spirit of the European Green Deal. I pay particular attention to pedagogical approaches and practical examples that promote critical thinking, collaboration and emotional engagement in digital learning environments.

The pedagogical foundations of digital experience-based learning

Education for sustainability is a complex pedagogical challenge that develops not only cognitive knowledge but also affective and social competencies. To gain a deeper understanding of learning processes, it is necessary to explore theoretical frameworks that link sustainability goals with the specific characteristics of experiential and digital learning environments.

Experiential education is based on David A. Kolb's model of experiential learning, which consists of four stages: concrete experience, reflective observation, abstract conceptualisation and active experimentation (Kolb, 1984). This cyclical learning model is particularly relevant in the context of sustainability, as it enables learners to process the complexity of environmental issues through their own experiences and to develop strategies for action. Digital tools – such as simulations, interactive games or VR applications – effectively support every phase of experiential learning.

Constructivist learning theories – particularly Vygotsky's sociocultural approach – emphasise the importance of social learning, linguistic mediation and cultural context (Vygotsky, 1978). Digital learning environments provide opportunities for learners to collaborate, co-create, reflect and give feedback to one another. Online platforms and tools promote learner autonomy, whilst also creating opportunities for facilitated, cooperative learning, thereby fostering democratic participation and critical thinking – key competences in education for sustainability (Lotz-Sisitka et al., 2015).

The convergence of experiential learning and digital environments plays a particularly important role in strengthening the affective dimension of learning. The aim of environmental education is not merely to inform, but to motivate, sensitise and engage learners (Palmer, 1998). Digital tools such as digital storytelling provide an opportunity for learners to connect with global ecological and social issues through their own experiences and emotions (Mihailidis & Thevenin, 2013).

Education for sustainability is inconceivable without the development of the key skills of the 21st century (4K: critical thinking, creativity, communication, collaboration), which play a key role in ensuring that learners can interpret environmental problems at a systemic level and develop complex solution strategies (Wals, 2011; OECD, 2020). These skills are closely linked to the development of attitudes that form the basis of active citizenship, democratic participation and an environmentally conscious lifestyle (UNESCO, 2020).

Critical media literacy is of paramount importance for sustainability, as the media provides not only a source of information but also a framework for interpreting the social perception of environmental issues (Anderson, 2017; Livingstone, 2019). The rise of digital media creates new opportunities for

active learning and community participation, whilst also increasing the risk of disinformation, greenwashing and emotional manipulation (de Freitas Netto et al., 2020). Developing media literacy, therefore, requires not only the acquisition of technical skills, but also ethical, social and environmental awareness (Hobbs, 2010; Jolls & Thoman, 2016).

Digital experience-based learning aligns particularly well with the concept of transformative learning, which aims to transform learners' worldviews, identities and patterns of behaviour (Sterling, 2010; Wals, 2012). Interactive learning environments – such as simulations, role-plays and narrative learning experiences – are well-suited to helping learners develop an emotional commitment to sustainability issues and form a personal connection with them. This is particularly important for strengthening the affective dimension of learning, which is a prerequisite for behavioural change (Ernst & Monroe, 2004).

Supporting student participation and autonomy is a fundamental prerequisite for students to act as responsible, active agents within their own communities. Collaborative project-based learning, action research and user-generated content provide opportunities for students to be not merely passive recipients but active shapers of the sustainability discourse (Powers, Saffer & Chen, 2022; Mihailidis & Thevenin, 2013).

Digital tools and platforms in sustainability education

The rise of digital technologies has radically transformed educational environments and created new opportunities for sustainability education in pedagogical practice. Access to information, networked learning, interactivity and the increased presence of visual elements can contribute to pupils' active participation, the development of their critical thinking, and a greater sense of emotional engagement (UNESCO, 2021a; Hobbs, 2017).

Among digital experience-based tools, gamified learning platforms stand out, as their motivational power promotes deeper understanding and long-term engagement. Minecraft: Education Edition, for example, enables learners to model ecological systems, make urban planning decisions or solve sustainability challenges within virtual worlds (Microsoft, 2023). Minecraft: Education Edition is a digital learning tool that, within a playful environment and grounded in constructivist pedagogy, provides opportunities to simulate

complex problems and to seek collective solutions. The platform is particularly well-suited to sustainability education, as it allows students to experience the interactions between environmental, economic and social systems through their own decisions. One of Minecraft's key educational modules is 'Sustainability City', in which students work on solving various challenges in an imaginary city. These include, for example, installing renewable energy sources, optimising water management, redesigning transport systems, or creating green spaces (Microsoft, 2023). Students achieve all this through their own construction projects, logical problem-solving and social collaboration. Beyond its experiential nature, Minecraft strongly develops problem-solving thinking, a systems-level perspective, and teamwork, whilst providing opportunities to make mistakes and redesign, which is a fundamental characteristic of environmental learning. Pupils are not merely passive recipients of knowledge but active creators of a simulated sustainable world, thereby increasing their emotional engagement and intrinsic motivation in the subject (Boeren, 2017; Hobbs, 2017). Minecraft also offers an opportunity for teachers to fully express their creativity: educational content can be freely adapted through custom lesson plans, thematic challenges and project tasks. In the field of sustainability education, for example, specific modules can be incorporated on topics such as climate change, consumer habits or biodiversity. One example is when pupils design their own sustainable school or community garden, taking into account ecological footprints, energy consumption and social needs.

Similarly, within the Classcraft system, pupils can experience collective responsibility in community and environmental action through collaboration, missions, and decision-making (Classcraft, 2023).

Digital quizzes, such as Kahoot! or Quizizz, reinforce knowledge playfully, whilst immediate feedback and a competitive spirit boost student engagement. These tools are suitable for providing a summary at the end of lessons, or for opening up a sustainability topic with thought-provoking questions as an introduction (Boeren, 2017). Digital storytelling can also be an effective tool in the sustainability discourse. For example, pupils can create their own videos, presentations or blogs about how they have made their own lifestyles more environmentally friendly. This method develops not only technological skills but also narrative thinking, empathy and reflectivity

(Mihailidis & Thevenin, 2013; Livingstone, 2019). The social dimension of learning is strengthened by the use of online collaboration tools – such as Google Workspace, Padlet or Miro. These platforms enable joint brainstorming, discussion, resource analysis and project planning. Learners not only create content but also become part of learning communities that convey democratic and sustainable values (Wals, 2011; Jolls & Thoman, 2016).

The pedagogical application of these tools can be truly effective only if learning objectives are designed in line with sustainability values and teachers act as facilitators to support critical engagement. Digital technology is therefore not an end in itself, but an opportunity to promote active student participation, emotional engagement and action for a shared future.

Interdisciplinarity and a values-based approach in digital sustainability education

The pedagogical strategies and content elements of education for sustainability have undergone a significant transformation in the 21st century, a key aspect of which is the rise of interdisciplinarity. The complexity of sustainable development means it cannot be addressed within the framework of a single subject or discipline, as understanding the functioning of natural systems, analysing economic factors, and taking social and ethical considerations into account can only collectively ensure the development of a sustainable mindset (Sterling, 2010; Wals, 2007). Digital tools play a key role in supporting an interdisciplinary approach. Multimodal forms of learning – interactive maps, data visualisations, online discussion forums, digital storytelling – enable learners to feel a sense of responsibility to synthesise information from different fields of knowledge and to reflect on it both individually and collectively (Jolls & Thoman, 2016; Livingstone, 2004).

A typical interdisciplinary project might, for example, involve developing a plan for a sustainable school that combines natural science (energy-saving solutions), social science (participatory decision-making), the arts (visual and narrative presentation), and digital competencies (interactive website or video production). Through such complex tasks, pupils not only integrate subject-specific knowledge but also develop a complex systems approach, critical thinking and creativity (Kolb, 1984; Wals, 2011).

Another key dimension of sustainability education is a values-based approach. Global environmental and social challenges can be understood through the lens of values and moral dilemmas such as responsibility, justice, solidarity, respect for wildlife, or the right to a healthy life. Digital learning environments – including game-based learning, storytelling, simulation programmes and online debates – provide opportunities to practise emotional engagement and reflection on values (Mihailidis & Thevenin, 2013; O'Neill & Nicholson-Cole, 2009).

The development of emotional intelligence is closely linked to maintaining motivation to learn and the effectiveness of social learning. Digital narratives – videos, blogs, podcasts – enable learners to connect with sustainability issues through their own experiences, thereby strengthening their identity, autonomy and moral stance (Kellner & Share, 2007; Livingstone, 2019).

Digital sustainability education must not separate the interdisciplinary structuring of knowledge from value-based, reflective learning. Effective educational practices are characterised by these dimensions being integrated into the pedagogical concept, not as complementary elements, but as mutually dependent ones. To this end, teachers also need to continuously develop their digital pedagogical culture and ensure that, within the framework of learning spaces and times, tasks that are authentic, relevant to real life and carry moral stakes are brought to the fore.

Didactic strategies and assessment options in digital sustainability education

Digital experience-based learning is not merely a technological innovation, but also represents a didactic shift in the field of sustainability education. Interactive, learner-centred, reflective, and realistic pedagogical approaches can only be effective if appropriate didactic decisions are made at every level of the teaching-learning process. When designing learning environments, active learning plays a key role, in which students are not passive recipients but active shapers of the learning process. Digital platforms – such as Minecraft Education Edition, Classcraft, Canva or Flip – enable learners to engage in project-based, collaborative, and reflective learning experiences by building on their visual, narrative, and problem-solving skills (Joubert et al.,

2021; Hobbs, 2010). Learning thus takes place not only on a cognitive level, but also on affective and social levels.

Within the framework of project-based learning, students undertake to solve complex, real-life problems, whilst the teacher supports them as a facilitator. In this type of learning organisation, students can design campaigns on sustainability issues, create academic or social media content, or even present their own views through digital storytelling tools.

Assessment is also aligned with this paradigm shift. Authentic forms of assessment – such as portfolios, self-assessment, peer assessment and digital presentations – enable students to track their own progress and receive feedback not only on the end product but also on their levels of collaboration, reasoning, creativity and environmental awareness (Anderson, 2017; Kolb, 1984). Gamification tools (scoring, badges, missions) also have a motivating effect, particularly for upper primary and secondary school pupils.

The transformation of the teacher's role is an essential prerequisite for digital, experience-based sustainability education. Teachers are not merely transmitters of knowledge, but also supporters, facilitators, curators and interpreters. For successful implementation, it is essential to develop teachers' digital competence and ensure they can evaluate available digital content from both critical and ethical perspectives (UNESCO, 2021b; NMHH, 2023).

Digital sustainability education is not a technological innovation for its own sake, but a tool for transforming the learning environment. The coordination of didactic strategies, forms of assessment, and teachers' roles creates the context in which learners not only learn about sustainability but also become its active, creative, and responsible shapers.

Summary

Digital media, gamification, simulations and digital storytelling offer opportunities for learners to engage with complex environmental and social issues in a deep, personally relevant and emotionally resonant way. Examples such as Minecraft Education Edition, Classcraft, and various online project platforms demonstrate that digital learning environments can reshape the familiar frameworks of knowledge acquisition, teaching roles, and assessment procedures.

However, we must also face several challenges in digital experience-based sustainability education. These include unequal access to devices, gaps in teachers' digital competences, difficulties in filtering quality content, and the constraints of teaching time and lesson schedules. Furthermore, presence in digital spaces raises new ethical and psychological issues: for example, information overload, distraction, or the danger of superficial, gamified learning experiences, which can easily undermine the value-centred goals of education.

Addressing these challenges, however, does not require rejecting technology but rather its conscious, reflective, and inclusive pedagogical application. Support for teachers, openness to digitalisation in teacher training and professional development, and access to Open Educational Resources (OER) and interdisciplinary curriculum models can all contribute to system-level changes.

The future of digital experience-based sustainability education lies in aligning technological possibilities with learners' engagement with the real world, value-based pedagogy, and the development of critical media literacy and social responsibility. If we succeed in creating learning ecosystems that simultaneously support the deepening of knowledge, emotional engagement and active participation, then digital education can truly be put at the service of sustainability.

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Zsolt Tömő

Strengthening Sustainability and a Preventive Approach in Higher Education

Abstract

The issue of sustainability is crucial in higher education, as universities are not only centres of knowledge, but also institutions that shape values and attitudes. Higher education plays a cardinal role in ensuring that students treat the fundamentals of sustainability as a priority. The Faculty of Health and Social Sciences at Gál Ferenc University strives to instil in the next generation values that will enable them to positively contribute to sustainability through critical thinking, ethical sensitivity, and a long-term preventive approach. Sustainability topics embedded in the curriculum (climate change, social inequality, global health) provide opportunities to develop moral and ethical thinking. Our university strives to integrate thematic elements into education to enhance students' preventive and intervention tools in health maintenance and health promotion.

At Gál Ferenc University, we offer a wide range of courses that prioritise the preventive approach across all departments. Gál Ferenc University offers opportunities that enhance sustainability, serve as examples, and highlight the constructive and significant role of higher education (e.g., a mentoring programme, cooperation with educational institutions and civil society organisations). Free psychological counselling and our student mentoring programme help improve student well-being and provide preventive support. Our goal is for students studying at our faculty to acquire the skills and knowledge that will help them to work in an empathetic, ethical, and prevention-oriented manner in their profession. One of the main focuses of our courses is to teach students preventive skills and integrate them into their practice. Climate change poses an increasing risk of infectious diseases. With rising temperatures and rainfall, dormant microorganisms may become active again, and new vectors may emerge. Through knowledge of the effects of climate change and sustainability, our students develop health awareness, professional development, and improved quality of life, thereby contributing to the well-being of their environment and society.

Keywords: *prevention, health, priority, climate change, sustainability*

Introduction

The importance of sustainability is increasingly recognised globally. The concept of sustainability, based on sustainable development, encompasses a holistic approach, consideration of the needs of future generations, a systems perspective and interdisciplinarity, as well as the consideration of needs, preferences and constraints, as it is upon these fundamental principles that subsequent implementation can be built (Simonyi & Zsótér, 2020). The Faculty of Social and Health Sciences at Gál Ferenc University seeks to strengthen the preventive mindset and the fulfilment of students' needs in higher education in line with these fundamental principles. The competence-based approach is a priority in the teaching methodology.

Education for sustainability itself contributes significantly to a deeper understanding of the problems and issues students face regarding sustainable development and enhances their problem-solving skills (Szabados, 2012). Lecturers must encourage students to think critically, act appropriately and make sound decisions (Szabados, 2012). A central element of courses related to sustainability is the acquisition of a practical, preventative mindset and its implementation. The university aims to impart a comprehensive approach that increases students' health awareness, enables them to improve their quality of life at both the individual and community levels, and helps ensure the proper functioning of their immediate and wider environments. The focus must not be merely on the transfer of knowledge, but on fostering an environmentally conscious attitude as the core of education and teaching (Besenyei, 2019). The subject areas of the Faculty of Health and Social Sciences are structured in accordance with these principles to provide students with the opportunity to acquire moral and ethical thinking and to form part of the sensitisation process.

The efforts of Gál Ferenc University to promote social, environmental and economic sustainability

Several programmes operating within the institution help to foster a culture of sustainability. The selective collection of hazardous waste and PET bottles

contributes to environmental sustainability, whilst the institution also participates annually in “TeSzedd!”, Hungary’s largest voluntary waste-collection campaign, involving its students. In collaboration with the Harruckern János Technical College and Boarding School of the Gyula Vocational Training Centre (GYSZC), we joined the charity clothing sale organised by UNICEF. In 2024, Building A of the Faculty of Health and Social Sciences underwent energy-efficiency upgrades, which are highly significant for the university’s more efficient operation from both environmental and economic sustainability perspectives. A mother-and-baby room has been established in the university’s Building B, which serves several purposes: on the one hand, it enables students to continue their studies whilst on parental leave, thereby reducing dropout rates; on the other hand, it strengthens the community network by promoting a family-friendly approach.

Higher education shapes adults’ mindsets and can be described as a ‘catalyst for change’ in sustainable development. The geographical distribution of this shift in mindset is uneven; not everyone has equal access to higher education (Žalėnienė & Pereira, 2021). From the perspective of social sustainability, the Faculty of Health and Social Sciences has introduced more optimised entry requirements, which facilitate students’ admission to higher education, whilst providing broader opportunities to obtain higher-level qualifications, thereby supporting labour market needs and contributing to a reduction in the number of shortage occupations. A student mentoring programme and free psychological counselling are also available within the institution. Community building at the university is supported by the board games club, which has been running for years, as well as the university café programme, which seeks to strengthen social cohesion through interesting lectures, not only for the members of the higher education institution. In the first semester of the 2023/2024 academic year, Gál Ferenc University joined the ‘Let’s Teach for Hungary’ Programme, in which the university’s students act as mentors to help primary school pupils from disadvantaged and multiply disadvantaged backgrounds catch up, strengthen their attitude towards further education, and broaden their horizons.

The Student Union (HÖK) aims to prioritise students’ environmental awareness and social engagement. The institution’s research group also seeks to focus on environmental awareness and sustainability by integrating

research platforms that can assist decision-makers in the long term. The Faculty's course offerings include numerous subjects that address all three dimensions of sustainability (environmental, social, and economic). The teaching of a preventive approach, health maintenance, health awareness, and environmental protection is delivered through subjects such as Health Education, Health Promotion, Sociology of Health, Psychology of Health, Public Health, Occupational Health, Biopolitics and Prevention, and Stress Management. Through the courses taught, students are enabled to develop a prevention-focused approach based on raising awareness, shaping attitudes and developing competencies.

Integrating a values- and prevention-based approach into education

The generation currently in higher education demands reflective thinking and rapid feedback. The challenge for the education of the future, beyond innovative technologies and methods, lies in developing and introducing a new kind of problem-solving thinking into teaching practice (Molnár, 2017). Universities convey the sustainability approach and principles to their students through their educational programmes (Náhlik, Bazsóné B. & Polgár, 2024). A key element in achieving sustainability goals is developing collaborative competence (Ercsey, 2023). With these findings in mind, curriculum developments are specifically aimed at developing competence and metacompetence, in addition to professional knowledge.

The impact of climate change on health, and the role of a preventive approach and attitude-shaping in education

Ozone layer depletion, soil, water, air, and food contamination, and climatic effects all contribute to the development of both non-communicable and communicable diseases. With global warming, mosquito breeding grounds have also expanded, thereby increasing the incidence of tropical diseases (Ádány, 2015). Due to high reproduction rates, the number of infected ticks is also higher, increasing the risk of an increase in tick-borne diseases. As a consequence of climate change, the pollen season is lengthening, and the risk of enteric infections is increasing (Tompa, 2008). The increased risk of cardiovascular diseases and respiratory morbidity can also be attributed to the effects of climate change. Conveying knowledge of these and other

environmental, social, and economic impacts is a primary consideration; at the same time, the preservation of health as a value and the promotion of individual well-being are integral parts of the teaching of public health and community health subjects. A proactive approach and a preventive mindset are essential for developing social sustainability and shaping health awareness at both micro and macro levels. In the undergraduate programmes of the Faculty of Health and Social Sciences, students acquire knowledge with a global perspective through health education and health promotion courses, centred on individual autonomy and social responsibility in relation to quality of life and well-being. A conscious, objective view of health is essential for maintaining student well-being, yet its elements are often assessed subjectively by young adults. A previous study highlighted that the mental, spiritual, and emotional aspects dominate students' perceptions of health in higher education, whilst the physical aspect was less emphasised (Szarvasné & Benkő, 2006). Our course curriculum aims to emphasise a holistic approach and to treat health as a priority. The university is committed to supporting students' mental wellbeing, seeking to achieve this not only through its course offerings but also by operating a mentoring network within the university. Beyond the mere transmission of information, the aim is to equip students with strategic tools that foster critical thinking, awareness and behavioural change. Previous research also highlights that institutions that integrate green competencies and sustainability into their teaching produce professionals who contribute to the long-term preservation of environmental values (Barna & Szalmáné Csete, 2021). In Public Health and Community Health courses, students acquire extensive knowledge in environmental health, food safety, and chemical safety. In higher education today, integrating a sustainability approach has become indispensable alongside the transfer of subject-specific knowledge. The 'Shift in Higher Education 2016' policy strategy also enshrines this directive, which includes reflecting on global challenges within the curriculum as a mandatory element (Mónus, 2024). We are developing the syllabus for our Public Health and Community Health courses in line with this directive, focusing on future challenges.

Summary

This study presents the strategic elements and main guidelines of Gál Ferenc University's sustainability approach as integrated into education. Higher

education plays a central role in imparting the principles of sustainability and shaping the mindset of future generations. On the one hand, it does so indirectly by training more qualified students who can bring about change to improve their own lives and those of their communities. Nowadays, it is almost expected in higher education that institutions contribute not only through education but also to the creation of social values (Király & Géring, 2020). Information relating to sustainability must be clear, accurate and coherent, adapting to the diverse contexts of the recipients (Djordjevic & Cotton, 2011). Sustainability is identified as a complex challenge in the strategies of many universities, one that requires coordinated, structured responses; at the same time, the emphasis must be placed on integration, planning, and measurable outcomes (Kukuruza, 2025). Among other things, efforts should be made to ensure that the sustainability approach is not treated as a mandatory element, but is given a complementary yet crucial role in the fields of health and social sciences. The research group operating within the university has set itself the goal of prioritising research across all three pillars of sustainability in the future; at the same time, expanding our range of optional courses (on sustainability issues) is also part of the university's innovative long-term educational policy.

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Szilvia Beke

Partnership for sustainability – cooperation between universities, local authorities and communities

Abstract

The implementation of sustainability in higher education is complex and relies on partnership networks linking multiple stakeholders, in which universities act not only as centres of knowledge but also as active social actors. The operation of higher education institutions is closely linked to the local and regional environment, where sustainability efforts are reflected in institutional strategy, community building and external collaborations alike. Local authorities and decision-making bodies contribute as strategic partners to sustainable infrastructure development, knowledge transfer and the strengthening of links between education and the labour market. Civil society organisations support social engagement, community learning and practice-oriented experience-building, whilst church partnerships reinforce a values-based approach, volunteering and social responsibility. Relationships with the corporate sector become pivotal through skills development, practical training and research and development partnerships. Cooperation between educational institutions and professional organisations ensures the continuity of a sustainability-focused approach and the integration of knowledge across different levels. Partnerships form a reciprocal and dynamic system in which the participants influence one another's operations. This networked approach enables the practical application of sustainability principles in education, research and community activities. Higher education thus functions not as an isolated institutional space, but as a system embedded in society, contributing to sustainable development.

Keywords: *sustainability, higher education, partnership, cooperation, community*

Introduction

The conceptual definition of sustainable development has undergone numerous transformations since its formulation by the United Nations in 1987. The concepts of sustainability and sustainable development have now

almost become part of everyday language, yet their meaning is viewed from different perspectives by different people. In everyday life, we primarily understand this to mean the careful management of resources, a practice whose roots stretch back to ancient societies, as even then the aim was to live in harmony with nature (Simonyi & Zsótér, 2020). In Dr József Tóth's socio-geographical approach, the natural and social spheres coexisted in the pre-industrial world without influencing one another. Thanks to development, a new space emerged in which the laws of both nature and society operated simultaneously; today, these two spaces have almost merged (Tóth, 2014). In this historically transformed and ever-changing world, the concept of sustainable higher education emerged in 2005, although it has been present in education since the 1970s. The Graz Declaration, adopted in 2005, calls on universities to prioritise sustainable development in their strategies and activities alongside education and research, and to collaborate with other universities and communities (Kis-Orloczki, 2023). The European Union's recommendation, which also prioritises education, was published in 2022; it acknowledges that sustainability itself is under-represented in curricula and that, in order to foster the appropriate mindset, emphasis must also be placed on the (Official Journal of the European Union, 2022). The above points clearly illustrate that the role of higher education extends far beyond the training of specific professionals and research conducted in the field; and it is also important that sustainability itself is reflected in the institution's strategy and that it can establish close partnerships with local and national decision-makers, employers, civil society organisations and the local population on a day-to-day basis, resulting in a network that is capable of acting on its own behalf in support of the cause.

Methods

Through the good practices and partnerships of Gál Ferenc University, this study seeks to illustrate the University's and the Faculty's sustainability efforts and the network of relationships that continuously shape and develop them. The author aims to present experiences and perspectives which, taking into account the organisational culture, create opportunities for other institutions to introduce or further develop these best practices.

Results

The university does not operate as an isolated institution, but is integrated into the social and natural environment surrounding it, where it strives to adapt resiliently to new challenges on an ongoing basis. At the same time, the University is a community hub where community building and shaping its mindset are equally key tasks. As an organisation serving as a centre of knowledge in a given field, it maintains dynamic relationships with its partners, whose roles are also continually evolving. Figure 1 attempts to outline the university's network of relationships, making it clear that no relationship is one-way, as they all continuously influence one another.

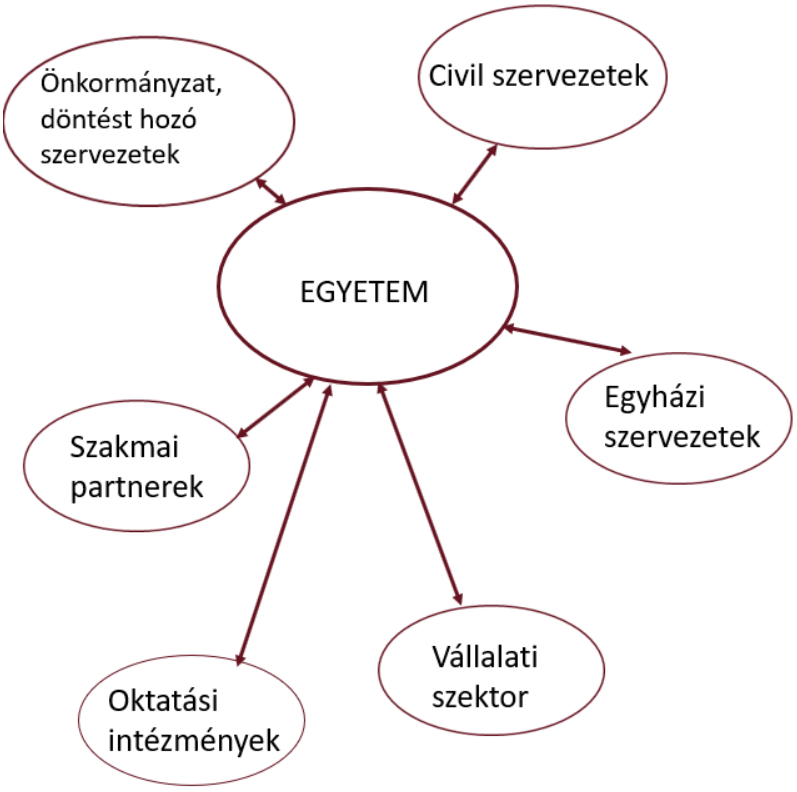

Figure 1. Network of university partners
Source: Figure compiled by the author

However, it is worth reviewing the effects of these partnerships by sector, as everyone is involved in these processes in different ways. Although the diagram is intended to illustrate only the university network, there is ongoing cooperation among the partners shown here, creating a living network.

Local authorities, decision-making bodies

In everyday life, local authorities or, in a broader sense, decision-making bodies often come to mind merely as regulatory bodies; however, their role is far more diverse and nuanced than this.

- The City of Gyula's sustainable urban development strategy fundamentally determines the university's operations and the direction of its infrastructure development. The strategy, however, was developed in partnership, preceded by a broad social consultation process involving not only the institution but also the local population.
- In the context of sustainable urban development, the city plays a key role in working with the University's governing bodies to find solutions that promote infrastructure development; nothing demonstrates this better than the energy efficiency and building renovation project carried out over the past year.
- At the same time, it acts as a bridge between the corporate sector and education, and creates opportunities for partnerships that serve the long-term interests of both parties.
- However, this bridge is also crucial when it comes to training and retaining young people locally. Last year saw the launch of the Damján Programme, in which our students can undertake internship roles; not to mention that, beyond the practical work experience itself, this contributes significantly to shaping our young people's outlook and developing their critical thinking skills.
- Its task is to facilitate knowledge transfer, which mutually supports the making of the most optimal decisions, as the County Scientific Council operating in Békés County invites stakeholders whose research findings and experience can also support decision-makers.
- Last but not least, the joint shaping of attitudes has succeeded in creating a comprehensive programme in the field of health communication, such as 'Health as a Shared Value'.

Overall, therefore, it can be said that local authorities and decision-making bodies are not merely regulatory entities, but active strategic partners in the realisation of sustainable higher education, contributing to the achievement of the aforementioned goals at institutional, economic and social levels.

Civil society organisations

Partnerships between universities and civil society organisations are crucial, as they promote the social application of knowledge and practice-oriented learning. Through these collaborations, academic research is more closely linked to real-world social and environmental problems, whilst interdisciplinarity and community-based knowledge production are strengthened.

- The social application of knowledge is well illustrated by the Pensioners' Academy, which has now been operating for more than 20 years, where two or three courses are advertised each semester, which not only seek to put the principle of lifelong learning into practice, but also function as a social safety net for the elderly.
- Similarly, social initiatives can be undertaken, such as the blood donation drive organised in collaboration with the Békés County branch of the Hungarian Red Cross, or the student first-aid competition. These events create further opportunities for our students through a concrete attitude of helping others.
- The Faculty's own Foundation, meanwhile, strives to create opportunities that support internal community building and a commitment to a life of research, thereby contributing to the development of a sustainable community.

Overall, university–civil society partnerships are strategically important for reinforcing the transformative role of higher education in the transition to a sustainable society.

Church organisations

All faculties of Gál Ferenc University operate in accordance with Christian spirituality and values and strive to pass on this approach to their students.

Partnerships between universities and church organisations contribute significantly to strengthening the social and ethical dimensions of sustainable

higher education by creating value-based spaces for cooperation that link academic knowledge with community responsibility and social solidarity.

Volunteering emerges as a key mechanism in this context, as it enables students to develop their sense of social responsibility, empathy and community skills through practical experience, whilst actively contributing to social well-being. The University's Community Service Office acts as an institutional bridge between the university and church and civil society communities: it coordinates volunteer programmes, structures the learning initiatives that support them, and ensures that these collaborations are sustainable from both educational and social perspectives.

Overall, the university–church partnership, through the mediation of the Volunteering and Community Service Office, contributes to the transformative mission of higher education, strengthening its social relevance, ethical foundations and community embeddedness.

Corporate sector

A key task of higher education is to continuously adapt to employers' expectations and the needs of professional training. However, this is inconceivable without joint thinking and curriculum development, as we are not necessarily talking about concrete professional knowledge, but rather about new competences and attitudes demanded by our constantly changing world.

At the same time, we must not forget that our Faculty prepares students for helping professions that are explicitly practice-oriented; it is with the help of these partners that we can ensure this is realised in a real-world work environment. For the Bachelor's degree in Social Work, students have had the opportunity since 2019 to participate in a dual training programme that further deepens this experience.

Looking to the future, the next stage of sustainable development can be achieved through joint research and development cooperation between the corporate sector and the university.

Educational institutions, professional organisations

Partnerships between universities and other educational institutions are fundamental to strengthening sustainable higher education, as they enable vertical and horizontal integration of knowledge across levels of the education system. These collaborations contribute to the continuity of a sustainability approach across primary, secondary and higher education, promoting long-term attitude formation and systemic learning. Our university has been working in partnership with the Gyula School District and the Békéscsaba and Gyula Vocational Training Centres for several years now. This collaboration has led to the implementation of numerous successful projects, including:

- The 'Be Healthy, Be Mindful, Be Health-Conscious' project, in which pupils from primary and secondary schools compete on a given theme, whilst familiarising themselves with local opportunities, and the higher education institution provides mentoring for the winning team.
- The competition for the 'Outstanding Nursing Student' and the 'Become the Best Healthcare Organiser in the Southern Great Plain' competition were launched by the University's Faculty to introduce secondary school students to the rewards of these caring professions. The latter competition, however, makes an excellent contribution to the development of a value system that emerges from an understanding of the region's architectural, gastronomic and natural resources, and through this shapes the students' attitudes.

At the same time, the implementation of these programmes would be inconceivable without the involvement of professional organisations, which, beyond concrete support, also lead to the formulation of further development objectives that can be realised through education and model curricula.

In summary, in the case of a higher education institution, achieving sustainability depends on a complex system of partnerships in which universities collaborate with local authorities, civil and church organisations, the corporate sector, and other educational institutions. This network of relationships enables the social application of knowledge, interdisciplinary collaboration and the integration of sustainability principles into education, research and institutional operations. The strategic implementation of all

these elements strengthens the social relevance of higher education and promotes its development.

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Balázs Nagy-Laczkó

Non-human beings in human roles: from trees as objects to trees as subjects

Abstract

In connection with the empirical research and findings presented in my other contribution to this volume, this short paper – also intended to offer a modest glimpse into the diversity of anthropological approaches – outlines one possible interpretation of human–tree relations, one that can be traced through various cultural-historical examples. In this spirit, and drawing on Antal Szerb's literary-historical analyses, I interpret the decadence of the late eighteenth century as a distinctive phenomenon of a self-reflective elite, whose longing for nature and critique of civilisation reveal an emerging premonition of its own decline. I argue that certain tendencies in contemporary orientations towards nature are likewise recognisable within these cultural patterns.

I juxtapose this historical framework with present-day manifestations of posthuman and Anthropocene discourses, in which trees increasingly appear as quasi-subjective actors amid growing interest in the climate crisis, the notion of resilience, and non-human ethnography. My central question concerns the extent to which such "subjectification" can be regarded as real: whether practices of ritualisation, naming, and care genuinely confer a form of communal status upon non-human beings, or whether they primarily reflect our own interpretive strategies and cultural techniques. I conclude that these gestures are underpinned by the uncertainties of our contemporary moment and its self-reflexive, often decadent modes of self-understanding, which fundamentally shape current relations to the natural world.

Keywords: *human-tree relations, non-human ethnography, posthuman approach, Anthropocene, decadence, longing for nature, critique of civilisation, climate crisis, cultural representation*

Approach

We cannot hide from the reader that the discipline to which the author of these lines has committed himself can, in fact, be interpreted and understood as the science of readings and interpretations (cf. Geertz, 1994, pp. 170–199).

The cultural anthropologist immerses themselves in their chosen field with empathy, be it a geographically definable, sweltering tropical jungle (see, for example, Malinowski, 1972; Lévi-Strauss, 1979; Boglár, 2008, pp. 112–115), or a hidden corner of the internet in the heroic age, such as a social media site with a small group of people who exist only virtually yet exert a real influence (Nagy, 2015; Lajos, 2016).

The field of anthropology may bear upon itself the attribute or descriptor of 'abstract' in relation to physical reality or the spatial definition of the natural sciences – yet whatever guise we clothe it in, it remains a field, just as it would be if stripped of all these elements (Eriksen, 2006, pp. 40–58). All this enables the researcher, whilst immersing themselves personally in printed and manuscript Old English texts (Barley, 2006, p. 13), sifting through notes received from others, and immersing themselves in the field in the archives, the library, or even in their bathtub (Voigt, 1966, p. 198), as if he were befriending young apprentices in the technical college courtyard (Willis, 2000), or finding himself among loan sharks and organised criminals (Durst, 2017, in particular: pp. 105–106) or simply felt like taking a stroll around one of the churches in their own hometown (Nagy-Laczkó, 2020). Moreover, this terrain may well be the terrain of related, associated, auxiliary–in short, other–disciplines. It is the anthropologist who frequently and gladly irritates the historian (particularly the micro- and mentalities historian), sociologists, psychologists, literary and drama scholars, and even those engaged in the natural sciences (particularly evolutionary biologists, ecologists and ethologists) by crossing the boundary and roaming freely through the territories they have conquered through decades and centuries of work. Inter- and transdisciplinarity, as a character and methodology–approaches that are often difficult to define precisely precisely because of their transitional nature and borrowed nature–are now taken for granted as inherent to a discipline that has always maintained a familiar and intimate relationship with economics, linguistics, philosophy, ethnography, archaeology, biology and so on, sometimes referring to one or the other as a father, a brother, a cousin or

even a child–a practice for which anthropologists can hardly be held to account, as scarcely anyone else troubles themselves more with the various questions of kinship. Naturally, the legitimacy of these cross-disciplinary ventures depends on their reciprocity. Consider, for instance, some of the better-known examples in our country: Sigmund Freud (1982, pp. 327–406; 1990) and Géza Róheim (1932; 1982; 2008, pp. 522–540); Marcel Mauss (2000, pp. 195–338) and Károly Polányi (2008, pp. 468–482), Pierre Bourdieu (2009), Konrad Lorenz (2002), and the list goes on.

However, one thing remains eternal: whether we sail the waters of the present or the near and distant past, we must hear the roar of the sea, feel the salty winds' sharp or gently warm caress – even if only in our imagination. The anthropologist, still a pearl diver today, dives into unknown waters to bring up their treasures. The anthropologist must learn to swim, must know what each wave means to him, and must be able to pass this knowledge on to the people of the mainland, accepting and knowing that, as always, completeness remains elusive. Today, too, he is a conscientious interpreter who immerses himself in his work, striving not only to make the text before him his own, but to become part of the text himself. Whether we regard his work as mirror translation, specialised translation, literary translation, or even outright rewriting is also an element of the internal discourse of this discipline, one that stems precisely from the self-reflexive nature of this field (cf., e.g. Niedermüller, 2008, pp. 428–438; Sárkány, 2008, pp. 439–451; Letenyei, 2012, pp. 165–166).

The Flowers of Decay

According to Paul Bohannan and Mark Glazer, the historian and the anthropologist share the same aim: to help our fellow human beings understand how people in different times and places organise, or have organised, their lives (Bohannan & Glazer, 2006, p. 19). We, too, must therefore start from afar, both in time and space, more precisely, in France in the second half of the 18th century.

Late Baroque, Rococo, pre-Romanticism: for some, the dawn of the Enlightenment; for others, its full flowering. There are many interpretations of the end of the ancien régime ('old regime') and of what led to the French Revolution. One of the most original interpretations, and one of particular

significance to our topic, is provided by Antal Szerb in several of his works (1965 [1943], pp. 222–246, pp. 329–342; 1978 [1934], pp. 200–209, pp. 219–230). In Szerb's view, Hans Naumann's theory of the gesunkenes Kulturgut (1922) – 'descending cultural assets' – is a fact that fundamentally defines and influences the entire history of culture at all times. In the writings of our literary historian, who is not without intuition, the mature Baroque elite, the beneficiaries of the ancien régime, are the semi-conscious agents of their own downfall. Szerb cites as an example that the ideas of the Enlightenment could first be voiced freely in royal courts and the salons of the nobility, so that later, through eavesdropping servants, these ideas, which would eventually shake the existing social order, could reach the ears of the lower classes. He highlights that in Hungary, the magnates close to the Viennese court were the chief proponents of Voltairean ideas – ideas that had arisen in direct opposition to their own privileges. Similarly, he regards, for example, the Rousseau-inspired enthusiasm for nature among Marie Antoinette and her circle, and the rise of English gardens in contrast to the strict geometric design of the French, as symptoms of decadence. This era – in his view – is aware of its sins, its fate, its ruin – and revels in them.

In this view, the slogan 'back to nature' is an anti-cultural, anti-civilisational phenomenon, a sign of social disillusionment – in short: the malaise of the elite. Our very term 'culture', derived from the act of cultivating the land–that is, transforming nature into a 'work'–carries within it, in our cultural sphere, the opposition between the achievements of civilisation and nature. Nature is so dangerous and hostile to the higher-order human that, for example, the perceived closeness of women to nature plays a role even in practices of the degradation of women by men (Ortner, 2003).

The common feature of decadent symptoms is not that they always appear in periods which posterity tends to regard as marking the end of an era, a moment of an age's overripeness or decline, but rather when those exhibiting these symptoms themselves view their own present in such terms. Whether we speak of the conflicted Roman authors during the decline of the Republic (Szilágyi, 1977, pp. 223–252), or of the Romantics disillusioned with the city in the age of urbanisation–such as E. T. A. Hoffmann (ibid. 1982a, pp. 24–28; 1982b, 176; Halász, 1982, p. 431)–or of Zsigmond Móricz (1960, 36, pp. 45–47)–the authors themselves always experienced this love of nature, embodied

in their depictions of the natural world, as chronicling a changing era, a world in decline.

We still experience this affinity for nature today, and since we experience it not elsewhere but in Europe, this affinity is of a romantic nature, in the sense of the term as defining a cultural-historical era. The romanticism of English gardens and Hoffmannian forests, in which Latin American and Scandinavian literature is experiencing its heyday. Without our reality, stripped of its magic by reason–that is, without our realism–the magical variant of realism would scarcely flourish in literature and cinema. Our age, just as Marie Antoinette's did in Szerb's interpretation, displays symptoms of decadence, which can also be detected in the expressions becoming increasingly popular in our social sciences. Instead of our definition of the present (postmodern), which can be seen as positive in its reference to the overcoming of modernity, we are increasingly using the negative-sounding late-capitalist term 'post-modernity', which refers to a sense of finality; this term expresses, in a typically decadent manner, a belief in the passing of the present and a longing for that passing, rather than being a scientific statement of fact. All this is supported by the simple fact that historians always draw the boundaries of historical periods retrospectively, never in advance – just as we have no idea whether, in this capitalist pool of ours, dubbed 'the late period', we have another 10–20 or even 400–500 years left to splash about in before it actually and definitively runs dry.

The case of the objective subject

In keeping with our subject, at the end of this essay-like piece, let us entertain the thought that Naumann's descending thesis on culture also applies to our love of trees, which has shifted from being a privilege of the intellectual and social elite to a public treasure. Let us approach the former park of the Wenckheim-Almásy Castle in Gyula, just as Géza Féja once did (1980, p. 121), or as Móricz did with the garden of the castle in *Úri muri* (1960, p. 36, pp. 45–47). Let us see in it both the senseless squandering of potential farmland and, precisely in this squandering, a lavish and evocative spectacle. Let us entertain the idea that the consideration of animal welfare and the associated ethically based vegetarianism and veganism, just as among the enlightened Voltairean French elite or certain Epicureans, as a way of life, still enriches the

range of our declining cultural assets today (cf. Montanari, 1996, pp. 15–25, pp. 88–94, pp. 176–180).

Having said that, let us examine the examples and findings of our study published in this volume (Nagy-Laczkó, 'Old Oak and Elm Seedlings…'), as well as those from our other research exploring the contemporary relationship between trees and people, in relation to the human-like and communal roles of trees (ibid. 2025a; 2025b; 2025c).

Finally, let us take a look at the current landscape of academic life, where a series of conferences and thematic calls for papers organised around the keywords of climate crisis, resilience, non-human ethnography (non-human ethnography, multispecies ethnography, other-than-human ethnography) await the next generation of researchers in the post-human and Anthropocene era to make their mark. A generation of researchers, many of whom are already embarking on their careers, is grounded in human ecology and human environmental science.

The change taking shape in scientific and cultural life, a change that is happening right before our eyes – one need only think of Ildikó Enyedi's latest film, *Silent Friend* (2025) – can be captured in the fact that, in the 'end times' (historical decadence), for adherents of a higher ethical standard (decadent elitism), beings equal to humans – trees, as non-human beings – step forward from being treated as environmental objects forming part of the landscape to becoming subjects playing a role as part of the community (see what we have written on the communal role of trees in our aforementioned studies: Nagy-Laczkó, 2025a, pp. 114–115; 2025b; 2025c, pp. 21–25). This practice and social phenomenon is not so much about trees, just as trees are not the true subjects of non-human ethnography (since it would be difficult to interview them or observe them in ritual actions), but rather about communities formed by real people. The objectification of the subject is a sleight of hand, a trick, but not magic: however much we regard the tree-lined avenues we have planted or the tree saplings endowed with charming names and lovingly tended as partners, we can never regard this partnership as mutual.

Antal Szerb believed he had uncovered the false virtues of a single social class behind the Rococo's loveless charm and emotionless love. An elite disgusted

with itself, which, in its benevolence and deep compassion, turned to those strata which it had previously by no means considered its own kind, nor even its equals. This elite sought the better in the other–precisely through that otherness–just as it did, and as we did, with 'primitive peoples' and 'noble natives'. Of course, we can hardly ignore the fact that this exaltation of others is at least as much an exoneration as it is a judgment upon ourselves.

In this essay, we have sought to offer an interpretation of a cultural phenomenon spanning the ages, without illustrating through specific examples how trees, as non-human beings, become subjects for humans. We have already done this elsewhere (Nagy-Laczkó, Old Oak and Elm Saplings…; 2025a; 2025b; 2025c), one might say – but in truth, there is something else behind this. For the author of these lines is himself uncertain as to how real and successful this subjectification of this particular object can be considered to be. To what extent does a non-human being truly become a member of the community simply because we perform rituals similar to those marking the human life cycle during their planting, nurturing and, ultimately, mourning? By protecting and tending to them, by planting them not merely as a memorial but by giving them memorial signs in their own right. From the fact that we give them names, endowing them with a protective, guardian role. From the fact that we know: they are 'born', they live and die, just as we do; that they are capable of accompanying generations; that not only can we watch them grow up, but they can watch us too.

The very ambiguity of these questions is a sign of the times: instead of positivism and objectivism, we are now surrounded by scientific syncretism, subjectivism and cultural esotericism. Poetic personification and symbolic practices are not merely the practices described, but are inherent to the description itself. Sharp contours are fading; with a slight delay, impressionism has also arrived in our narratives.

The only certainty that perhaps remains is that whatever a person speaks of, they are always discussing themselves and their own era at the same time.

It is no different when it comes to trees.

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Edit Hajnal

Forest in the Mind – Mental Well-being and Environmental Diversity

Abstract

From the perspective of mental well-being, the connection with nature can be interpreted as a psychological resource that influences attentional functioning, emotional balance, stress response and everyday coping strategies alike. The significance of green spaces and biodiversity cannot be captured merely in terms of physical presence, but also in the context of accessibility, usability, quality of experience and socio-cultural conditions. The relationship between mental well-being and the green environment, therefore, requires an interdisciplinary interpretation that integrates psychological, ecological, urban planning and pedagogical perspectives. Based on attention restoration and stress regeneration approaches, natural environments can contribute to the relief of directed attention, cognitive restoration, the reduction of rumination and the alleviation of physiological stress. Biodiversity emerges as a qualitative dimension of green spaces that can support psychological restoration through sensory richness, naturalness, and the experience of discovery. However, these positive effects cannot be separated from mediating factors such as noise pollution, air quality, shade or safety.

In the Hungarian context, forest schools, forest pedagogy, green pedagogy, and eco-pedagogy represent institutionalised frameworks that transform connections with nature into learning, community, and well-being experiences. These practices support not only ecological awareness but also attentional regeneration, social connection and long-term attitude formation. A connection with nature can thus be understood as an area where mental wellbeing, community learning and environmental diversity intersect.

Keywords: *mental wellbeing, connection with nature, biodiversity, forest pedagogy, green space*

Introduction

A connection with nature is not merely an experience tied to the external environment, but also an internal psychological 'mental space': experiences of nature and natural ecosystems can influence attention, emotional balance, stress responses and everyday coping strategies (Bratman, 2019; Dudok, 2026). A connection with nature can therefore be regarded simultaneously as a lifestyle factor, a psychological resource and a set of socio-spatial conditions.

Urbanisation, sustained cognitive load, a barrage of digital stimuli, noise and heat stress, a sedentary lifestyle and social isolation can all contribute to mental exhaustion and impaired well-being (WHO, 2022).

Access to green spaces is not the same as their use, nor is use the same as restoration. Accessibility, accessibility for people with disabilities, and cultural norms all determine whether green spaces are truly accessible and what quality of experience they provide. For this reason, the interpretation of the green space–health relationship is necessarily interdisciplinary: it integrates epidemiological, psychological, urban planning, pedagogical and ecological perspectives (Engemann, 2019).

This study aims to summarise the empirical findings on the relationship between green spaces and health, and between biodiversity and mental well-being, and to formulate conclusions that can be applied in practice through the metaphor of 'mental space', with a particular focus on forest schools in Hungary, forest pedagogy, green pedagogy and eco-pedagogy.

Conceptual background and definitions

The concept of green space refers to areas covered by vegetation or partially vegetated, whether natural or artificially created (Twohig-Bennett, 2018). It can also be interpreted as infrastructure, as the spatial structure of everyday life determines how much time and effort is required to access it, and thus also how likely its regular use is. The distribution of urban green spaces often reflects social inequalities, as their provision is typically lower in less advantaged neighbourhoods.

Biodiversity refers to the variety of living organisms and captures the qualitative dimension of green spaces: parks of the same size can differ significantly in species richness, vegetation stratification, and perceived

naturalness (Wood et al., 2018). More biodiverse spaces may offer greater visual and sensory complexity, which may be relevant to psychological restoration.

Mental health and mental well-being are related but not identical concepts. Mental health focuses on the absence of psychological disorders and functional functioning, whilst mental well-being also encompasses positive psychological dimensions – such as life satisfaction, resilience and adaptive emotional functioning (Keyes, 2007). A connection with nature relates to both dimensions and is linked to reduced distress and increased positive well-being indicators.

The emphasis on the unity of physical and mental processes is also evident in the Hungarian literature: Weninger interpreted health as a dynamic unity of physical and psychological functions, realised through the interaction between the organism and its environment (Weninger, 1942). Within this framework, the connection with nature is not an external, additive factor, but part of the system of relationships between humans and their environment. Similar patterns of dynamic interaction between environmental, economic and social systems can be observed in real-world contexts, such as the historical development of the Channel Islands, where long-term adaptation illustrates the systemic interdependence of human and environmental processes (Zádori, 2020).

Theoretical framework: The restorative power of nature

Attention Restoration Theories

Attention Restoration Theory (ART) focuses on the fatigue of directed attention and its regeneration (Berman, 2008). Nature's stimuli can relieve the burden of sustained, effortful attention, thereby promoting cognitive restoration. Modern lifestyles demand sustained directed attention, which can lead to cognitive exhaustion and difficulties with emotional regulation (Kaplan, 1995).

Restorative environments have four fundamental characteristics: being away, fascination, extent and compatibility (Hartig, 1991). Restoration is thus not merely an occasional 'outcome', but also the conscious design of everyday

spaces: routes, rest points, reduction of noise and heat stress, and a transparent spatial structure.

Flow theory complements the interpretation of restoration. According to Csíkszentmihályi (2001), the state of optimal experience arises when an individual's abilities and the challenges posed by the environment are in balance. Activities carried out in nature can often create such conditions, and flow, as an integrated state of attention, can push self-focused thoughts into the background and stabilise emotional regulation. Flow and ART are complementary mechanisms: the former emphasises attentional integration, the latter the relief of directed attention.

Stress-recovery approaches

Stress-recovery models – particularly Ulrich's psycho-evolutionary theory – suggest that natural environments may facilitate faster recovery than urbanised spaces (Ulrich, 1984). According to this approach, the visual and structural characteristics of nature can reduce the physiological stress response, mitigate negative affect and promote the restoration of balance in the autonomic nervous system. Prolonged stress may be associated with a decline in cognitive control and a weakening of executive functions; experiencing nature can therefore be interpreted as a dual resource: it can reduce the stress response and support cognitive regeneration. Empirical findings suggest that cortisol levels may decrease in forest environments, and certain immunological indicators may improve (Li, 2010).

Biodiversity and psychological restoration

Biodiversity can influence the quality of the experience of green spaces through several mechanisms: species richness and structural diversity can increase multisensory stimulation, enhance the experience of discovery and curiosity, and contribute to the perception of naturalness and expanded learning opportunities (Soga, 2016). At the same time, interpreting the link between biodiversity and well-being requires caution. It is not clear whether positive psychological outcomes stem directly from species richness or are instead linked to other favourable environmental factors associated with it – such as shade, noise reduction or better air quality. Nevertheless, biodiversity

can be effectively integrated into planning alongside well-being and climate adaptation objectives.

The importance of a connection with nature for well-being – international examples from Asia to Europe

The importance of a connection with nature for well-being is evident in many cultures around the world. One Asian example, the Japanese practice of shinrin-yoku (forest bathing) (Li, 2010), focuses on mindful presence and stress reduction, whilst wabi-sabi can support psychological resilience through the acceptance of simplicity and transience. Norwegian friluftsliv interprets being in nature not as a recreational activity but as a philosophical practice (Gelter, 2000). Allemansrätten – the institutionalised right of public access to the countryside – ensures low-threshold access to nature in Scandinavia at both a legal and cultural level (Sandell & Fredman, 2010). The Danish cultural concept of hygge, which manifests as a social form of cosy togetherness, comfort, and emotional security, is also being examined in international well-being research, among other fields (Nielsen, 2021). The common message of these examples is that a connection with nature can function as a sustainable, repeatable daily practice. From an educational perspective, the institutional framework of green schools and the gamification of sustainability can also provide a relevant toolkit (Baranyai, 2024; Dudok, 2024).

Forest schools and the Hungarian context

Social and institutional frameworks are necessary for the long-term maintenance of a connection with nature (Soga & Gaston, 2016). In Hungary, such a framework is provided by forest schools and forest pedagogy, which offer organised learning and experiential opportunities. The example of the 'Forest in School' programme indicates that outdoor environmental education is present as an institutionalised practice. Forest pedagogy can thus be interpreted as a communal space that provides a structured experience of nature, contributing to stress reduction and strengthening social bonds.

Green pedagogy and eco-pedagogy aim to foster an understanding of ecological systems and the development of active competence (Dudok, 2024a; Wals, 2002). Community garden projects or habitat development can

strengthen self-efficacy and community embeddedness, whilst well-being-oriented planning requires balance to ensure participation does not become a pressure to perform.

Measurement and operationalisation

Satellite vegetation indices (e.g. NDVI) are often used to measure green space; whilst these are suitable for large-scale comparisons, they do not reflect usability or the quality of the experience (Kabisch et al., 2015). Objective measurement of biodiversity is based on ecological surveys, whilst perceived biodiversity can be captured using questionnaire-based tools and may be more closely linked to psychological experience (Soga & Gaston, 2016). Self-report scales are typically used to measure mental well-being; in an educational context, it is particularly important to use age-appropriate, ethical and non-stigmatising measurement practices. However, this study is primarily interpretative and not based on empirical research.

Results and interpretation: The intersection of practice and research

The relationship between green spaces and mental well-being

The literature examining the relationship between green spaces and mental well-being identifies several interrelated mediating mechanisms. These include stress reduction, attentional and cognitive recovery, promotion of physical activity, and opportunities for social connection and meaning-making (Gascon et al., 2015). Indicators of residential green exposure are relevant because they indicate the basic conditions for daily contact with nature; however, proximity does not equate to quality. The use of green spaces that are in poor condition, noisy, or pose safety risks may remain limited, which can weaken the well-being effects (Barbosa et al., 2007).

Rumination and attentional fatigue

One short-term psychological outcome of experiencing nature may be a reduction in rumination. Rumination – repetitive, self-focused thought patterns with negative content – is a known cognitive risk factor for the persistence of depressive and anxiety symptoms (Nolen-Hoeksema, 2000). Nature's stimuli can relieve the burden on directed attention, reducing self-

focus. Findings suggest that even brief but regular experiences of nature can contribute to stress management and psychological stability (White et al., 2019). A connection with nature can thus be understood as a practice that can be integrated into everyday life. Travel and recreational experiences in nature can also be linked to improved mental well-being and quality of life, particularly in the context of psychological regeneration and the flow experience (Dudok, 20205; Tömő & Beke, 2023).

Educational impacts and long-term patterns

In the school setting, brief, structured nature experiences are particularly relevant, as attention span and learning performance are directly linked to environmental conditions (Dudok, 2024b; Ohly et al., 2016). In this context, a connection with nature is not merely a leisure activity, but a key determinant of the quality of the learning environment. In the longer term, forest school programmes and similar practices can foster attitudes and behavioural patterns that embed a connection with nature as a stable value in individual and community practices.

Limitations and future research directions

One of the main limitations of the literature examining the relationship between green spaces and mental health is that a significant proportion of the research is cross-sectional, allowing only limited causal inferences (de Vries et al., 2003).

Furthermore, confounding factors (socio-economic status, choice of residence, health behaviour) may also influence the associations, and measurement methods (vegetation indices, self-reported well-being indicators) require cautious interpretation.

It remains an open question whether objective species richness or perceived biodiversity is more closely linked to psychological effects, and what mediating role nature competence plays. Further studies are also needed to explore which social groups benefit most from biodiverse environments.

Summary

The study examined the relationship between green spaces and mental well-being within an interdisciplinary framework, integrating approaches focused

on attention restoration, stress regeneration, and biodiversity (Kaplan, 1989). Based on the results, a connection with nature can contribute to psychological stability through several interrelated mechanisms: it can moderate the stress response, support cognitive recovery, and strengthen social and meaning-making processes. However, the potential for well-being depends not only on the presence of green spaces but also on access, environmental quality, cultural practices, and institutional frameworks. Forest schools and forest education programmes in Hungary can be understood as institutionalised forms of connection with nature, in which mental wellbeing, ecological awareness and community learning can be linked within a single practice.

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