Journal of Sustainability Perspectives 5 (3), 2025, 414-436

Journal of Sustainability Perspectives

journal homepage: https://ejournal2.undip.ac.id/index.php/jsp/

University Nature Trails as Experiential Tools for Shaping Student Sustainability Attitudes: A Case Study from the University of Sopron (Hungary)

András Polgár[*1], Veronika Elekné Fodor[1], András Náhlik[1], Dóra Németh[1], Márton Tóth[1], Árpád Őrsi[1], Enikő Pásztor[2], Ferenc Lakatos[3], Attila Fábián[4]*

[1]*Faculty of Forestry Institute of Environmental Protection and Nature Conservation, University of Sopron*
[2]*Vice-rector for Education, University of Sopron*
[3]*Vice-rector for Research and Foreign Affairs, University of Sopron*
[4]*Rector, University of Sopron*
[*]Corresponding author: polgar.andras@uni-sopron.hu

Article Info

Received:
21 June 2025
Accepted:
22 September 2025
Published:
31 December 2025

DOI:
10.14710/jsp.0.29870

Abstract. University nature trails are innovative forms of experiential learning and environmental education that foster sustainability awareness, student engagement, and well-being. This study examines the impact of the nature trail located on the campus of the University of Sopron on students' sustainability-related attitudes and behaviors. The research applies a mixed-methods approach: narrative and institutional case studies are complemented by a quantitative survey with 916 valid responses. The case study presents the conceptual background of the trail, its design and implementation process, and its integration into the university's educational and community life. It highlights the cultural and local significance of the trail, as well as its connection to the sustainability efforts of higher education in Central Europe. The quantitative survey assesses students' knowledge, confidence in applying sustainability principles in practice, and opinions on the university's environmental initiatives (e.g., selective waste collection, use of renewable energy sources, and green infrastructure). The findings indicate a high level of interest in environmental issues among students, yet gaps remain in translating sustainability knowledge into consistent, everyday actions. The case study reveals that the trail provides a place-based, experiential learning environment that strengthens emotional bonds with nature, supports interdisciplinary learning, and fosters community engagement. By linking theoretical knowledge with direct experiences, it enables deeper understanding and helps bridge the gap between knowledge and action. The combined methodological approach offers a comprehensive view of how experiential learning environments can influence sustainability awareness. The study presents a Central European example in which sustainability education is embedded in local values and a nature-

based setting, supporting behavioral change and community building in higher education.

Keywords:
university campus, sustainability, student attitudes, environmental education, nature trail, experiential learning

1. Introduction

Sustainability is one of the most pressing social, economic, and environmental challenges of our time, and it deserves special attention in higher education. Universities are not merely institutions for knowledge transmission; they are also value-shaping communities where future decision-makers and professionals are formed. Therefore, it is of paramount importance that the principles of sustainability are organically integrated into education, campus culture, and students' everyday lives.

The discourse on sustainability affects and engages broad segments of society, including younger generations—particularly university students, who represent the future intellectual elite. Whitley et al. [1] emphasize that engaging with university students is especially important, as they are receptive to acquiring new knowledge and their attitudes can be shaped relatively easily.

Concina and Frate [2] conducted a comprehensive literature review on the topics of sustainability and sustainable development. Their research, which analyzed twenty relevant studies, revealed that student interest in sustainability issues has increased in recent years. Consequently, it is crucial for universities to take sustainability expectations into account. However, the study also found that students primarily associate sustainability with its environmental dimensions. This aligns with the dominant sustainability practices on most university campuses, where environmentally focused initiatives tend to prevail [3].

Students' attitudes toward sustainability are influenced by a range of factors, including region, gender, field of study, and age [4]. For instance, the study by Aikowe and Mazancova [5] highlighted those Nigerian students generally have limited knowledge of sustainability, although students in agricultural fields demonstrated above-average understanding. McCormick et al. [6] reported that female students show a higher level of commitment to sustainability, and students who participated in extracurricular activities and internships tend to exhibit greater sensitivity to the topic.

At Kyoto University, a study investigated students' knowledge of the Sustainable Development Goals (SDGs) [7]. The results showed that 73.7% of students were aware of the UN's sustainability goals, with most having first encountered them during coursework. However, the study also revealed that students do not fully understand the essence of each goal. One of the article's recommendations is to link the SDGs more closely to students' everyday activities in order to enhance comprehension.

According to a study conducted in Portugal [8], a relative majority of students (47%) fall into the category of individuals who are concerned about climate change and actively

contribute to a more sustainable future through their personal actions. These actions are primarily focused on waste management practices—such as prevention, recycling, and selective collection—as well as on social engagement and volunteerism. In contrast, a negligible proportion of students (less than 10%) were found to be sceptical about climate change and showed no willingness to change their lifestyles to support sustainability goals.

A study conducted at a university in Thailand also examined students' attitudes toward sustainability [9]. The students were divided into two groups based on whether they had taken a sustainability-related course. The results showed that those who had participated in the course demonstrated significantly higher commitment to sustainability and possessed notably greater knowledge on the subject. Their findings support the integration of sustainability courses into university curricula, as such courses effectively increase students' awareness and engagement with sustainability issues.

The study by Ahamad and Ariffin [10] on overconsumption highlights that while students often possess knowledge about sustainability, their practical engagement tends to be moderate. Similar conclusions were drawn by Ovais [11], who found that students' sustainability knowledge significantly exceeds their practical implementation. A common underlying factor identified in these cases is a lack of internal self-regulation. These findings align with the conclusions of Teather and Etterson [12], who also emphasize the discrepancy between knowledge and action.

University sustainability is a multifaceted concept. Nagy [13] conducted an online questionnaire survey among students at the University of Miskolc. Respondents were asked to rate 21 aspects of sustainability on a five-point scale in terms of perceived importance and how well their university performs in each area. The results indicate that selective waste collection is the most strongly perceived element among the students. In addition, students identified the use of renewable energy sources and the importance of water and energy conservation as key factors in achieving campus sustainability. Ribeiro et al. [14], in their study at a Brazilian university, found that sustainability-related events contributed to enhancing students' sensitivity to sustainability issues.

According to a Hungarian study [15], students strive to lead a sustainable lifestyle; however, their efforts are often hindered by convenience and a lack of information. Thus, there is a noticeable gap between declared intentions and actual behaviors. One of the key conclusions of the study is that sustainability attitudes tend to be stronger when students have financial or other personal interests in the topic—for example, when purchasing second-hand clothing or electronic devices.

The empirical studies presented in the previous paragraphs provide a significant theoretical foundation and offer a detailed picture of university students' attitudes toward sustainability topics. However, these investigations typically do not address how these attitudes manifest in practice or what behavioral consequences they entail. In contrast, our research examines the practical internalization of sustainability attitudes and their behavioral expressions, thereby contributing to students' environmental awareness and a deeper understanding of sustainability.

University nature trails are designated paths located within or near higher education campuses, designed to showcase natural, cultural, or historical values while providing on-site educational opportunities [16]. These specialized facilities serve multiple purposes in higher education, including promoting experiential learning, increasing environmental awareness, supporting research opportunities, and strengthening the relationship between universities and their surrounding communities [17]. For instance, the University School of Milwaukee

regularly guides students along nature trails and through outdoor classrooms on its 125-acre campus, emphasizing the importance of learning in close connection with nature [18]. University nature trails provide a tangible link between theoretical knowledge and the real-world environment, offering a unique pedagogical tool for students. Functioning as outdoor classrooms, they enable students to directly observe and engage with concepts discussed in lectures and readings, thereby deepening understanding and enhancing knowledge retention.

The history of nature trails dates back to the early 20th century, first emerging in the United States (1925) and Germany (1930) [19]. In Hungary, the development of nature trails in their modern form began in the 1970s, alongside similar efforts in Switzerland [19]. The initial purpose of university-based nature trails was often to provide practical support for science education, offering students opportunities to study botany, zoology, and ecology in real-life settings. The rise and spread of nature trails in higher education over the past century reflect the growing pedagogical recognition of experiential learning and environmental education. While originally perceived perhaps as recreational supplements, the increasing institutional adoption of nature trails indicates a shift toward more practice-oriented and environmentally focused teaching approaches. This historical evolution underscores the enduring significance of connecting students with nature as an integral part of their academic journey.

Amid growing environmental challenges, increasing demand for sustainability, and a broader recognition of the importance of mental health, university nature trails are assuming an increasingly vital role in student education, research, and community engagement [20]. Researchers at the University of Utah, for example, have demonstrated that walking in nature enhances cognitive functions [21]. In a world that is becoming increasingly urbanized and environmentally strained, university nature trails offer crucial opportunities for students to reconnect with the natural world. These spaces promote environmental literacy, enhance well-being, and support essential research related to ecosystems. As society becomes more disconnected from nature, universities have a responsibility to provide avenues for students to experience and understand the natural environment. Nature trails offer an easily accessible means of fulfilling this need, contributing not only to individual development but also to broader societal goals related to sustainability and environmental conservation.

University nature trails offer numerous educational benefits, serving as ideal venues for experiential learning. Students can directly observe and experience what they are studying, fostering deeper understanding and critical thinking [22]. Many universities integrate nature trails into various courses, such as biology, ecology, environmental science, geography, archaeology, and even art programs [23]. The Texas Tech University Outdoor Learning Center, for instance, provides curriculum-aligned, hands-on educational experiences through its trails [24]. University nature trails transcend traditional classroom boundaries, offering dynamic outdoor learning environments that enhance student engagement, promote interdisciplinary connections, and provide memorable educational experiences. By moving learning outdoors, these trails cater to diverse learning styles, making abstract concepts more tangible and understandable. This active participation in the natural environment can spark curiosity, develop problem-solving skills, and lead to a deeper, more lasting comprehension of the subject matter.

University nature trails also offer significant environmental benefits, serving as effective tools for promoting environmental awareness, conservation, and sustainability [25]. They help visitors learn about and appreciate nature, thereby increasing their commitment to

environmental protection and encouraging sustainable behavior. The University of Pannonia's Green Campus Nature Trail, for example, showcases various aspects of sustainability, such as energy saving and waste utilization [26]. Cornell University's sustainable landscape trail highlights sustainable design solutions on campus, offering practical examples of sustainable operations [27]. University nature trails act as powerful instruments for environmental education, raising awareness of ecological principles, promoting conservation efforts, and fostering environmentally conscious thinking among students and the wider community. Direct engagement with the natural environment through these trails can cultivate an emotional connection to nature, making environmental issues more personal. This increased awareness and emotional commitment can lead to a greater willingness to adopt sustainable practices and advocate for environmental protection.

University nature trails also provide significant health and well-being benefits. Spending time in nature has been proven to reduce stress, anxiety, and depression, while improving mood and concentration [28]. Nature trails offer an opportunity for relaxation and rejuvenation in a natural setting [29]. Regular exercise on these trails contributes to maintaining physical health, improving cholesterol levels and reducing the risk of chronic diseases [30]. The Rice Creek Field Station at SUNY Oswego, for example, offers nearly 5 miles of trails for recreation and learning about the natural environment [31]. University nature trails provide easily accessible avenues for promoting the physical and mental well-being of students, faculty, and staff, offering a natural refuge for stress relief, exercise, and rejuvenation amidst the demands of academic life. The pressures of university can take a toll on mental and physical health. Nature trails offer a convenient and cost-effective way to encourage healthy lifestyles and much-needed respite within the university environment, contributing to a more balanced and productive academic experience.

Finally, university nature trails also serve as valuable community-building tools. Many university nature trails are open to the general public, fostering connections between the university and the local community, facilitating knowledge sharing, and promoting a shared commitment to natural values [32]. The John Lambert Nature Trail at Berkshire Community College, for instance, is accessible to both the college and the community, creating opportunities to enjoy and learn about the natural environment [33]. By sharing their natural resources, universities can build stronger relationships with their surrounding communities, offering opportunities for intergenerational learning, promoting local tourism, and showcasing their commitment to public service and environmental stewardship. Universities have a responsibility to create spaces that are accessible and inclusive for everyone. This means not only physical accessibility but also considering cultural factors, language barriers, and ensuring that the benefits of nature trails are available to all segments of both the university community and the wider public.

The above has shown that university trails are widely present in higher education institutions around the world and contribute to the institution’s social responsibility. Most of them present the knowledge generated at the university in a case study-like manner; however, scientifically rigorous, comparable, and comprehensive empirical research on them is still considered lacking. The majority of the examined studies lack practical support with measured data, especially in the areas of attitude formation and behavior change. The University of Sopron aims to fill this gap, taking into account Central European, Hungarian, and local characteristics, including the university community and particularly students’ behavioral patterns. There is a need for research that examines not only declared attitudes but also their practical internalization and behavioral consequences, especially in response to

real educational interventions — such as university trails.

Designing a successful university nature trail requires a holistic and iterative process, integrating ecological science, pedagogical principles, accessibility standards, and user experience considerations to create a trail that is both educational and enjoyable [34]. The design must consider the target audience, trail length, terrain conditions, the natural and cultural values to be showcased, and the pedagogical objectives [35]. It is crucial to take into account visitors' physical and cognitive abilities, areas of interest, and available time during the planning phase [36]. The trail layout should strive for variety and the presentation of interesting sights, avoiding monotonous sections [37]. Adhering to sustainable design principles (e.g., drainage, erosion control) is essential to minimize environmental impact [38]. Designing an effective nature trail is more than just marking a path. It demands a deep understanding of the local ecosystem for its preservation, clear articulation of learning objectives to guide content and layout, a commitment to inclusivity so that everyone can participate, and an awareness of user needs to maximize engagement and satisfaction. This multifaceted approach ensures that the trail achieves its stated goals and provides a valuable resource for the university and the community.

The scientific contribution of the present study is novel in several respects. Firstly, from a methodological standpoint, the study represents an important innovation by examining the impact of a specific pedagogical tool—the university trail—not only within a theoretical framework or as a case study but through a questionnaire survey based on quantitative methods. This allows for the measurement and comparison of sustainability attitudes among students who have had varying degrees of exposure to the trail programs. The data obtained in this way contribute to understanding how experiential learning can promote commitment to sustainability.

The study is also unique in that it interprets the university trail not merely as an environmental education tool but as a complex educational platform that simultaneously serves knowledge transfer, the development of emotional attachment to nature, and the community experience. Thus, the research contributes to the redefinition of the role of experiential learning within sustainability pedagogy.

The aim of the present study is to explore the role university nature trails, as tools promoting experiential learning, can play in shaping sustainability awareness. The research focuses on the example of the University of Sopron, where a nature trail is intended to bring the practical implementation of sustainable development closer to students. Drawing on domestic and international literature, as well as an empirical survey, the study examines students' attitudes towards sustainability, their level of knowledge, and the educational potential of nature trails. It is important to highlight that the study examines a specific tool for shaping sustainability attitudes — the university trail — within the context of the Central European higher education region. While an increasing number of empirical studies appear in the international literature on the impact of education on sustainability, these investigations typically focus on institutions in Western Europe, Asia, or North America. The example of the University of Sopron provides an opportunity to explore the potential impact of a domestic, locally rooted, nature-based learning environment on students’ perspectives.

2. Methodology

At the University of Sopron, a survey was conducted to assess students' attitudes. A quantitative methodology was employed, consisting of an online questionnaire developed

using Microsoft Forms. When designing the questionnaire, we aimed to minimize the time required for respondents to complete it. The questionnaire included binary questions, Likert scale items, single-choice questions, as well as questions offering more than two response options. To gain a deeper understanding of students' opinions, we also included short, open-ended questions.

The questionnaire was distributed through internal mailing lists and via personal outreach and requests. It was sent to students in October 2024, and a total of 916 responses were received. Among the respondents, 56% were female and 44% were male. Responses were collected from students of the institution's four faculties: Benedek Elek Faculty of Pedagogy, Faculty of Forestry, Simonyi Faculty of Engineering, Wood Sciences, and Applied Arts, and the Lámfalussy Sándor Faculty of Economics. To encourage participation, small gifts were raffled among respondents after completing the questionnaire.

The questionnaire titled "Investigation of Sustainability Attitudes among Students of the University of Sopron" aimed to map students' knowledge, attitudes, and behavioral intentions related to sustainability. The structure of the questionnaire followed a logical sequence, first collecting demographic and background data of the respondents, then addressing questions related to sustainability knowledge and attitudes, and finally focusing on specific behavioral intentions and personal experiences. The variables measured by the questions can be grouped into four main categories: (1) demographic and background variables: these included faculty, year of study commencement, program name, and gender. These are nominal or ratio-scale variables of primarily descriptive nature, enabling the breakdown of results by subgroups, (2) sustainability-related knowledge and attitudes: the questionnaire used both open and closed questions to measure cognitive and affective attitude components. The cognitive dimension was measured, for example, by exploring concepts associated with sustainability (open question), self-assessment of subjective knowledge level (1–10 star scale), and familiarity with sustainability rankings. The affective dimension was captured through items such as the role of sustainability in university choice, the evaluation of the importance of various sustainability measures (1–6 Likert scale), and the perceived importance of appearing in university rankings, (3) sustainability behavioral intentions and practical attitudes: this category included questions measuring conative components, such as willingness to enroll in sustainability courses, interest in student sustainability events, willingness to use bicycle and scooter fleets, or interest in the reuse center. Multiple-choice questions explored transportation habits and preferences, while confidence in selective waste collection and actual knowledge level were measured by separate questions: the former used a self-assessment scale, the latter a specific knowledge test (identifying the correct collection bin for aluminum cans), and (4) knowledge of and interest in the Sustainable Development Goals (SDGs): the questionnaire investigated whether students had heard of the UN's 17 SDGs and asked which goals they were most interested in (multiple answers allowed).

The measurement methods applied in the questionnaire operationalized the three main components of sustainability attitudes (cognitive, affective, conative). The cognitive component was measured through self-assessment scales, knowledge tests, and open questions. The affective component was assessed using Likert scales, ranking tasks, and preference selections. The conative component, or behavioral intention, was examined using dichotomous (yes/no) questions, categorical scales, and open descriptions of actions.

For validation purposes, the questionnaire's design incorporated a combination of various question types, a comparison of cognitive and practical knowledge, and the inclusion

of open questions to enhance internal validity, which strengthens the reliability of the measuring instrument. Motivation was supported by a prize draw, which significantly improved the response rate.

Overall, the questionnaire examined students' sustainability attitudes, knowledge, and behavioral intentions in a complex manner by integrating multiple measurement methods, making it suitable for providing a comprehensive picture of the target group's views on sustainability and potential patterns of action.

Developing students' sustainability attitudes is crucial for the future generation to make responsible decisions and actively participate in achieving sustainable development. In this process, university nature trails can emerge as exciting and effective tools. The University of Sopron also has a nature trail located on its campus. The purpose of this trail is to showcase local natural values to students and visitors, as well as to highlight good practices related to sustainability.

Before describing the nature trail, however, it's important to understand the University of Sopron's "Sound of Earth" program. "Sound of Earth" is also a philosophy: The sound of the Earth finds understanding ears through the efforts of the University of Sopron. The work, research, and measures undertaken by the institution form an organic whole, aiming for the practical implementation and development of sustainability. Its goals are the development of green infrastructure and the shaping of public awareness. Its milestones include achieving net-zero climate neutrality, promoting climate and nature positivity, and conveying the message of environmental consciousness [39].

Figure 1. Sound of earth label [39] © Copyright. University of Sopron. All rights reserved

The University of Sopron, applying a systems-based approach rooted in sustainability criteria and its best practices, has established the University of Sopron Sustainable University Model. In its Institutional Sustainability Strategy, it defines its vision and SMART goals, to which it assigns an Implementation Program. Through university-wide measures and work packages (WPs), the model supports the realization, operation, and continuous development of the Sustainable University.

The SOE–FEM (University of Sopron – Sustainable University Model) is embodied in a pyramid model, aiming to create a university operational culture that prioritizes sustainability, which can then spread to other sectors and the wider society.

Building upon its Sustainability Strategy, the University of Sopron launched its

trademarked "Sound of Earth University of Sopron" Implementation Program (SOE–MP). This implementation program, featuring various measures (thematic work packages), is aligned with the UN Sustainable Development Goals (SDGs) and provides a framework for the complex practical implementation and continuous development of the institutional sustainability culture.

A key element of the SOE-MP is the "University as a Living Lab Concept" approach, which serves as a framework for the work packages and measures. The Living Lab concept encompasses: the multifunctional use of the green and built university environment in service of sustainability efforts; enabling students, educators, mentors, researchers, and employees to develop their ideas in a real-world setting and examine their implementation through feedback loops. During the implementation of measures, the balance between theories and practical realization is paramount. The individual SOE–MP work packages are as follows: Partnership, Planet, People, Wellbeing, Peace [39].

The nature trail located in the Botanical Garden begins with an introductory sign that presents various sustainability themes using eco-friendly labels. The main themes include a Nature-Positive University, Energy Awareness and Efficiency, Waste Management and Recycling, Water Management and Water Conservation, Sustainable Transportation, Culture and Community, and Sustainability in Education and R&D&I activities.

On the nature trail, visitors can access the main collection pages via QR codes placed at each station, where digital content aids in learning about the specific attraction. The QR codes lead to the University of Sopron's Green University subpage, which serves as the digital hub of the nature trail, providing visitors with further details about the university's sustainability efforts. The starting point for the thematic navigation system can be found at the following URL: https://greenuniversity.uni-sopron.hu/labels-sustainability. The nature trail has 30 stations, thematically categorized into the following 6 main categories: (1) Nature-Positive University: Botanical Garden, Nature trail, Conifers in the Botanical Garden, Hedgehog-Friendly Campus, Mushroom World of the Botanical Garden, Nature-Positive Activities, Insect World in the Botanical Garden, Bird-Friendly Campus, Treejoy project, (2) Energy Efficiency and Renewable Energy: Biomass boiler, Solar Panels, Energy saving devices in the Botanical Garden, (3) Waste Management and Recycling: Selective waste collection, Waste Reduction (Reduce) Programs, E-waste, (4) Sustainable Water Management: Rainwater Harvesting, Paired plot hydro-meteorological studies, Elizabeth Spring, (5) Sustainable Transportation: Traffic reduction solutions, University bicycles, Bicycle Service Points, Accessibility, (6) Education and Research: Wildlife Management and Hunting Collection, Soil Monolith Collection, Herbarium, Meteorological Station, Partridge Enclosed Breeding, GreenBee, Ligneum, Student Communities.

3. Results and Discussions

As part of the University of Sopron's "Sound of Earth" Program, the nature trail showcases sustainability through thematic units. The main themes include the Nature-Positive University, energy awareness and efficiency, waste management and recycling, water management and water conservation, sustainable transportation, culture and community, and sustainability in educational and research activities.

3.1. Nature-Positive University

The main campus of the University of Sopron, along with most of its educational

buildings, is situated within the 100-year-old University Botanical Garden. This garden serves educational purposes, acts as a living plant collection, and contributes to nature conservation, conservation biology, and recreation. Additionally, the Forestry Science Institute (ERTI), which is part of the university and primarily focuses on research while also performing educational tasks, is organically linked to the institution. ERTI includes five Experimental Stations (in Sopron, Sárvár, Budapest, Mátrafüred, and Püspökladány) and three Arboretums (in Sárvár, Kámon, and Püspökladány).

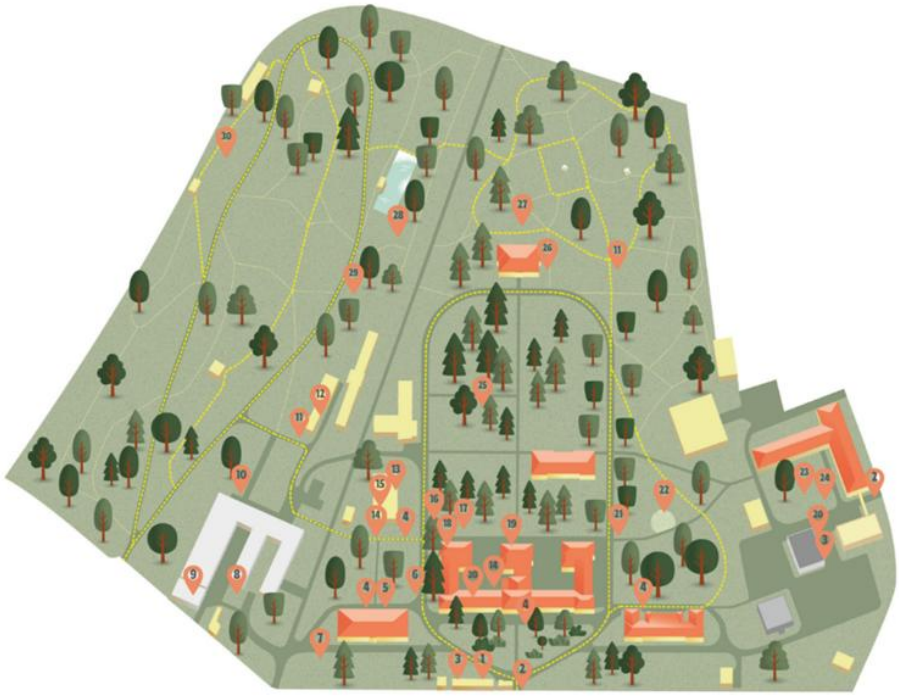

Figure 2. Stations of the Botanical Garden Nature Trail © Copyright. University of Sopron. All rights reserved

Legend: 1. Botanical Garden, 2. Traffic reduction solutions, 3. University bicycles, 4. Selective waste collection 5. Soil Monolith Collection, 6. Gymnosperms in the Botanic Garden, 7. Waste reduction (Reduce) programmers, 8. Biomass boiler, 9. E-waste, 10. The Botanic Garden's fungi, 11. Nature trails, 12. Energy saving devices in the Botanic Garden, 13. Nature-positive activities, 14. Accessibility, 15. Ligneum, 16. Paired plot hydro-meteorological studies, 17. Bird-friendly campus, 18. Herbarium, 19. Wildlife and Hunting Collection, 20. Bicycle service point, 21. Hedgehog Friendly Campus, 22. Elizabeth Spring, 23. Student communities, 24. Solar panels, 25. Meteorological station, 26. Rainwater harvesting, 27. Insect world in the Botanic Garden, 28. Keeping a Grey Partridge indoors, 29. GreenBee, 30. Treejoy project

The global network of the "Nature Positive Universities Alliance" was launched by the United Nations Environment Programme (UNEP) in collaboration with the University of Oxford to support the prioritization of nature restoration within the higher education sector. Globally, over 400 universities and, through them, numerous researchers, students, and experts have already joined the network. This significantly contributes to the UN Decade on Ecosystem Restoration and the Sustainable Development Goals (SDGs). The advantage of this collaboration is that universities can share their experiences and learn from each other's best practices. Universities play a crucial role in shifting environmentally destructive activities towards restoration, as students, as future leaders, will directly impact the planet and the state of the natural environment through their acquired knowledge and mindset, as well as

being future landowners, managers, and consumers.

Figure 3. Nature Positive University label [39] © Copyrights. University of Sopron. All rights reserved.

Higher education institutions that are members of the "Nature Positive Universities Alliance" can verify and monitor their efforts in biodiversity protection and achieving carbon neutrality. They can also improve their sustainability practices within their operational processes and supply chains on campuses and in their surrounding communities.

In 2022, the University of Sopron was among the first to join the initiative as a founding member. It assessed its baseline status and recorded its development programs ("Nature Positive Pledge") through SMART goals. This made it not only a founding member but also the first Hungarian registered higher education institution in the "Nature Positive Universities Alliance." The university's most important goals were the comprehensive development of the Botanical Garden (campus development), moving towards institutional carbon-neutral operation, and the university's afforestation program (Loyalty Forest). The institution reports on its achieved and measurable results in annual reports [39].

3.2. Energy Efficiency and Renewable Energy

In recent years, the University of Sopron has made significant efforts in the field of energy awareness. The institution aims to reduce its ecological footprint and set an example in sustainable development.

The university received significant recognition in 2023, becoming Hungary's First Carbon-Positive University. This title is a testament to our institution's outstanding sustainability efforts. The developments implemented in Sopron not only make the university's operations greener but also serve as exemplary best practices for the entire country. Carbon-positive operation means that the university actively contributes to mitigating climate change. We prioritize sustainability principles in all areas of the university's activities. The most significant step was the establishment of biomass heating plants; these modern facilities utilize domestic dendromass to provide heating for several university buildings.

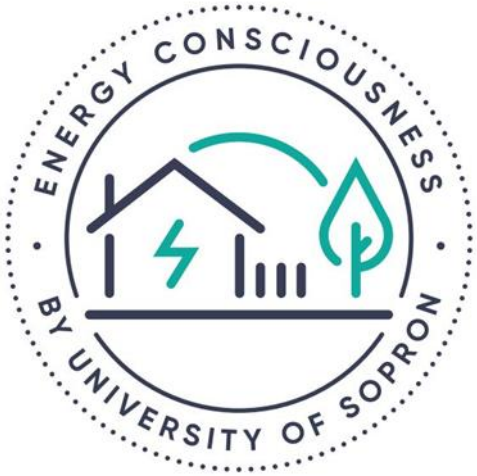

Figure 4. Energy consciousness label [39] © Copyright. University of Sopron. All rights reserved

As part of the energy development, three new heating centers were built at the main campus on Bajcsy-Zsilinszky Street, the VUK and LUK dormitories on Baross Road, and the Benedek Elek Faculty of Pedagogy. A total of 3,700 kW of additional renewable energy-based capacity was established across the three sites: one 2,000 kW and two 850 kW automatic wood chip boilers were put into operation. These boilers receive wood chips from hydraulically operated movable floor fuel storage units, which are loaded by tipper trucks [40].

The three heating centers collectively supply thermal energy to a total heated floor area of 56,726.4 m² across 22 buildings. The heating center on Bajcsy-Zsilinszky Street heats 17 buildings of the main campus (36,927.25 m²) with a 2,000-kW boiler that can store enough wood chips for a week, supported by 12 1,000-liter buffer tanks for continuous operation. The heating center at the Benedek Elek Faculty of Pedagogy supplies the faculty building, dormitory, and kindergarten (10,051.35 m²) with an 850-kW boiler, complementing the existing condensing boiler system. The heating center for the Baross Road dormitories (9,747.8 m²) supplements with an 850-kW biomass boiler, aiming to replace district heating-based heat production where possible [40].

As a result of this investment, the University of Sopron reduces its greenhouse gas emissions by 1,675.85 tons of CO^2 equivalent annually, achieving climate-positive operation as the first Hungarian university to do so. The expected energy generated from renewable sources is 15,861.67 GJ/year, and the annual primary energy consumption reduction for public buildings is 4,406,020 kWh/year [40].

In addition, we have implemented numerous other measures at the university that contribute to increasing energy efficiency and environmental protection. By increasing the proportion of energy-saving devices and widely applying renewable energy sources, energy consumption has become significantly more efficient. During the design and renovation of university buildings, special attention is paid to green and timber architectural solutions. Natural light, natural ventilation, and systems capable of natural building climatization (e.g., shading by vegetation) also play an important role [40].

The university also has programs to reduce GHG emissions across several emission scopes (Scope 1, 2, 3). For example, we encourage environmentally friendly transportation

among employees and students by supporting cycling and public transport. As a result, based on our performance in 2023, the University of Sopron was recognized by the government with the Advanced Cycling-Friendly Workplace designation. Furthermore, we are gradually transitioning to using purely electric vehicles for the institutional vehicle fleet, based on their intended use [40].

The good practices of the University of Sopron demonstrate that the energy awareness and efficiency of higher education institutions also play an important role in sustainable development [39].

3.3. Waste Management and Recycling

The University of Sopron is committed to sustainability and environmental awareness, making significant efforts to reduce waste generation and enhance recycling based on its "3R (Reduce, Reuse, Recycle) waste management program." We have implemented numerous measures across the university to decrease paper and plastic consumption and increase the effectiveness of selective waste collection.

Figure 5. Waste Management and Recycling label [39] © Copyright. University of Sopron. All rights reserved

The 3R waste management program is an environmentally friendly approach that emphasizes reducing waste generation, reusing existing waste, and recycling.

Reduction means producing less waste, primarily through prevention. This includes actions like buying fewer packaging materials or composting organic waste. At the university, everyday practices include double-sided printing and electronic document management to avoid unnecessary printing. We have also reduced paper waste by digitizing administrative processes (e.g., financial authorization processes). Organic waste is composted on-site in the Botanical Garden.

Recycling means processing waste into secondary raw materials, which can then be used to produce new items. The goal of 3R waste management is to lessen the environmental burden, conserve natural resources, and promote sustainable development.

Our selective waste collection extends to separate collection for paper, plastic, glass, mixed waste, green and organic waste, metal, and hazardous waste (e.g., batteries, accumulators, toners, used chemicals). At the university, we continuously strive to reduce

waste generation by following the principles of the waste hierarchy, prioritizing reuse and recycling.

At the University of Sopron, we pay special attention to involving every member of the university community in our sustainability efforts. Our goal at the university is to play an exemplary role in environmental awareness and ensure long-term sustainable operations [39].

3.4. Sustainable Water Management

To care for and maintain the green areas and spaces of the University of Sopron, it is necessary to retain and utilize natural water resources and rainwater to the greatest extent possible on-site. Due to extreme climatic conditions, increasingly long dry periods are expected, while the existing drainage system cannot adequately manage and store the sudden runoff from heavy rainfall. Conscious, sustainable, and systematic management of rainwater, which includes the development of blue infrastructure networks and their integration with green infrastructure elements, can provide a solution to this climatic challenge. Green areas are also suitable for establishing on-site rainwater management systems through the creation of smaller or larger rain gardens, reservoirs, and multifunctional rainwater treatment spaces. Innovative technical solutions must be introduced for the drainage problems caused by extreme rainfall. To maintain high-quality green spaces—also due to the effects of climate change—ensuring irrigation is essential. The necessary water quantity for this should primarily be supplied by utilizing groundwater and rainwater, and only secondarily by more economical use of drinking water.

The University is already doing a lot on both fronts and is continuously developing its water management. The primary solution is rainwater harvesting in the Botanical Garden, which now takes place at three different locations. Two underground tanks next to the Ligneum building serve this purpose, and three interconnected, newly installed surface tanks next to Building E and the Botanical Garden greenhouse ensure the collection and subsequent use of valuable rainwater. With these tanks, we can save 85-90 m^3 of tap water annually, which is a huge help not only in terms of cost but also environmentally.

In addition, the number of water-saving faucets and infra-flush toilets in buildings and dormitories is continuously expanding, allowing us to save further valuable cubic meters of water for our planet [39].

3.5. Sustainable Transportation

The University of Sopron is committed to sustainable mobility, making the shift to environmentally friendly transportation a high priority for daily commutes to work, classes, and during assignments. Our location offers excellent conditions for our everyday activities, as our three Sopron campuses and dormitories are all accessible within a 10-minute walk or a 5-minute bike ride.

Cycling, as a means of sustainable micromobility, plays a prominent role at our university and has a long tradition. Numerous bicycles have been distributed among the institution's employees, fully equipped and considering technical and safety aspects. In addition, bike storage facilities and ergonomic bike racks are available next to all our buildings, and we have also set up two public DIY bicycle service points.

Figure 6. Sustainable water management label [39] © Copyright. University of Sopron. All rights reserved

Figure 7. Sustainable transport label [39] © Copyright. University of Sopron. All rights reserved

To motivate lecturers, students, and staff, we launched the "Stroll with us to Selmec!" and "Bike with us to Selmec!" programs. These initiatives utilize information technology and mileage tracking to also encourage a healthy lifestyle.

On our campuses, we restrict the use and entry of private cars. Our aim with this is to preserve the undisturbed wildlife of the Botanical Garden and to reduce harmful emissions. This is supported by a barrier and a license plate-reading smart camera system. Underground garages are also available for vehicles on some campuses.

We support public transport through employee travel pass subsidies. Sustainable mobility is of paramount importance to the University of Sopron, and we will continue to place great emphasis on its further development and improvement in the future.

The botanical garden nature trails are equipped with information boards that introduce various plant and animal species, as well as the local ecosystem. The nature trail also includes an energy efficiency exhibit, where visitors can learn about renewable energy sources and energy-saving solutions.

The University of Sopron's newest specific, thematic "Sound of Earth" green university

nature trail plays an important role in the environmental education of students. During a visit to the nature trail, students can gain practical experience in sustainability and better understand the importance of the natural environment. The nature trail also provides an opportunity for relaxation and rejuvenation, contributing to students' mental and physical well-being [39].

3.6. Education and Research

The University of Sopron is a prominent intellectual, educational, and research center in the Western Transdanubian region of Hungary. Education at the university's four faculties is rooted in centuries-old traditions. The Forestry Science Institute, which recently became part of the University of Sopron, was founded in 1898. The institute's research and development projects serve sustainable forest management across various scientific disciplines (ecology, forest management, forest breeding, forest protection, silviculture, forest asset management).

Figure 8. Sustainable Education and Research label [39] © Copyright. University of Sopron. All rights reserved

The University of Sopron strives to shape the natural, social, and human-made environment, aiming to preserve and improve quality of life through environmentally conscious thinking. It nurtures ethical and human values, seeking to contribute to the development of the region and the entire country through its operations.

With its model change (transition to a foundation-maintained university), the university has placed sustainability at the core of its activities across education, research, services, third mission, and institutional operations. Due to its history, it has always embraced the "Green University" concept in its spirit. Its strategic goal is to be a "continuously renewing, authoritative, university knowledge center in Central Europe," focusing on developing green infrastructure and shaping societal attitudes. It aims to achieve its milestones of net-zero climate neutrality, climate and nature positivity by actively involving university students and the public in conveying the message of environmental awareness.

Sustainability is highly emphasized and increasingly permeates our daily operations. Our university is uniquely capable of imparting knowledge on the intensive and sustainable management of forest ecosystems and the timber derived from them, which forms the foundation of a sustainable forest-based economy. Beyond natural science, climate

adaptation, and engineering research, we also approach the complex issues of sustainability from environmental education, pedagogical, as well as economic and social science perspectives.

Through its sustainability activities and performance, the University of Sopron is building for itself and for the future. As Hungary's "Green University," stemming from the aforementioned approach, we are fully committed to all initiatives that serve economic, social, or natural sustainability. This attitude is also conveyed by the university's motto, "Naturally With You!", which centers on the individual and nature [39].

3.7. Results of the Sustainability Attitude Survey

Sustainability-related knowledge and attitudes: The results of the attitude survey conducted at the University of Sopron indicate that the majority of students are aware of the concept of sustainability and consider a sustainable lifestyle important. However, the survey also highlighted gaps in students' knowledge regarding certain areas of sustainability. The most frequently cited obstacles to adopting a sustainable lifestyle were convenience and a lack of information.

According to the survey results, students are interested in the University of Sopron's nature trail and would be keen to visit it. Students believe that the nature trail could contribute to increasing their environmental awareness and expanding their knowledge of sustainability.

When asked about their confidence in sustainability knowledge, respondents rated their self-assurance on a ten-point scale, with ten indicating the highest level of confidence. The average score was 6.27; however, variations were observed across faculties. Students enrolled in environmental protection and technical knowledge programs demonstrated significantly higher confidence in this area.

We also examined students' opinions on which areas they considered priorities for the university to become more sustainable. Promoting selective waste collection was deemed the most important, followed by the transition to renewable energy sources, and then prioritizing the physical and mental health of students.

Sustainability behavioral intentions and practical attitudes: In our research, we also asked students if they would participate in optional sustainability courses and, if so, what topics they would be interested in. 64% of respondents expressed interest in a course. Students studying subjects where sustainability topics are less emphasized in the curriculum showed greater interest in such elective courses. Those in social sciences and economics were more open to environmental sustainability topics. Sonetti et al.'s survey [41] also supports our conclusion that the acquisition of sustainability competencies should be integrated into curricula, regardless of the field of study. The most popular topics were climate change prevention, water management issues, and the dilemmas of sustainable urban and regional development. It's worth noting that interest in ESG (environmental, social, and governance) courses was low, which may suggest that this topic has not yet entered students' awareness.

One well-known element of sustainable university initiatives is the realization of sustainable transportation goals. Therefore, we found it justified to include a separate question addressing students' expectations in this area. Respondents could select multiple options supporting sustainable transportation. More thoughtful organization of timetables proved to be the primary expectation, chosen by approximately 70% of students. This aligns with the efforts of Texas A&M University [42]. Implementing this would reduce micromobility within the university campus. Two-thirds of students considered public transport support

important. 53% of respondents believed it is necessary for the university to provide bicycles for university citizens to achieve these goals.

Figure 9. Key areas for the University's journey towards sustainability

Regarding selective waste collection, we asked students how confident they felt in this area. Informative posters on selective waste bins across the university aid the university community in proper sorting. 84% of students consider themselves confident in selective waste collection. Of these, 37% base their confidence on their own knowledge, while 47% rely on the university's informative posters. However, an analysis of responses to the next question complicates this picture. When asked where to dispose of aluminum cans in the city of Sopron, only 43% of respondents answered correctly, identifying the plastic waste bin (this is a local specific). 53% of respondents incorrectly stated they would place empty aluminum cans in general waste. The lack of knowledge regarding selective waste collection among Hungarian university students is also supported by Lukács et al. [15]. This uncertainty is primarily observed among male students.

The reuse center enjoys broad support (681 yes votes). In the ranking of nature-positive university characteristics, the most important were judged to be the green environment, environmentally friendly operations, and the protection of biodiversity.

Knowledge of and interest in the Sustainable Development Goals (SDGs): One of our questions addressed awareness of the UN's Sustainable Development Goals, investigating whether students are familiar with these goals. According to our results, slightly more than one-third (34.5%) of students were aware of the goals. Different proportions were observed between genders and among students of various faculties. This figure is clearly low for us, and students know the goals in a smaller proportion than we expected. The most popular SDG topics were quality education (515 respondents), health and well-being (500 respondents), clean water and sanitation (461 respondents), and the protection of oceans and seas (471 respondents).

The University of Sopron is committed to promoting sustainability. In this spirit, the university regularly participates in various sustainability rankings, such as the authoritative UI

Green Metric World University Rankings, to validate the significance of its efforts. We believe it is important that all members of the university community feel ownership of our participation in these rankings and the achievements gained. 73% of students surveyed consider it essential that our university participates in these rankings, which reflects widespread student support for involvement in these assessments.

4. Conclusions

The most important practical significance of the research lies in supporting the view that university campus trails are not merely ecological or landscape architectural facilities but also effective educational and attitude-shaping tools. The example of the University of Sopron has demonstrated that these infrastructures are capable of bridging the gap between theoretical knowledge and practical actions related to sustainability. Research suggests that students are interested in the topic, but often lack knowledge, and this knowledge doesn't always translate into practical action [10-12]. University nature trails offer an innovative solution that can bridge this gap. The fact that the overwhelming majority of students are open to visiting the university trail and believe that it can contribute to increasing their environmental awareness sends a clear signal to universities that these tools can be valuable complements to sustainability education. Through direct contact with the natural environment, these trails promote experiential learning, deepen students' understanding, and increase environmental awareness [22]. Furthermore, nature trails contribute to the mental and physical well-being of students and the university community and strengthen the connection between the university and the local community [32], [33].

The research highlighted that knowledge related to sustainability is not sufficient—the students' confidence and willingness to take action fall short of the desired level. The study emphasizes that the design and management of nature trails is a complex task that considers ecological, pedagogical, and community aspects [34, 35]. Successful nature trails are attractive, educational, accessible to all, and managed sustainably for long-term success [36], [37]. Integrating technology and community involvement can further enhance the effectiveness and popularity of nature trails [38, 43]. Based on this, we recommend that universities further develop their experience-based, experiential learning support programs. The thematic elements of university trails can be integrated into courses, project assignments, and can serve the goals of interdisciplinary learning. The interest in sustainability courses also reinforces the need for universities to develop thematic modules aligned with the lessons learned on the trails.

The study can contribute to domestic and international higher education sustainability policies by providing concrete examples and data on the effectiveness of experiential learning. The use of the university campus as a "living laboratory" aligns with sustainability transformation frameworks (e.g., UI GreenMetric, SDG goals, Nature Positive Universities). The approach presented here can serve as a model for other universities, especially those committed to carbon neutrality, green infrastructure, and educational innovations.

An important scientific conclusion of the research is that students' interest and attitudes can be positively influenced through field experiences. This supports the validity of constructivist and experiential pedagogical models in higher education as well. University trails offer opportunities for integrated teaching across various disciplines (biology, ecology, economics, arts, etc.), thus supporting inter- and transdisciplinary education, which also appears as a key competency in ESG training programs.

From a scientific perspective, the research points to several possible future directions.

On one hand, longitudinal studies are needed to track the extent to which experiences related to university trails influence students' long-term attitudes and behaviors. On the other hand, comparative studies among different universities, involving students with diverse geographical, sociocultural, and academic backgrounds, are necessary to explore the components of environmental education effectiveness.

The University of Sopron's nature trail serves as a good example of how such a facility can be utilized for student education and to further sustainability efforts. Through this, it can be demonstrated that university trails serve not only educational but also community-building purposes. Public access, community events, and opportunities for intergenerational learning contribute to strengthening community sustainability attitudes as well. The survey results indicate that students are open to the opportunities offered by the nature trail and are interested in expanding their knowledge of sustainability. Thus, universities can be not only catalysts of knowledge but also catalysts of social change.

Future research should delve deeper into the impact of university nature trails on students' sustainability attitudes and behavior. Based on the results, we recommend that leaders of higher education institutions strategically integrate sustainability trails and experiential learning environments into their educational and research infrastructure. Further studies are needed to explore differences among various types of nature trails, teaching methods, and student groups. In addition, training educators in the pedagogical use of trails is necessary, as well as the development of policy incentives that facilitate their integration into institutional sustainability programs. Additionally, it would be important to measure the economic and social impacts of nature trails, as well as to identify best practices and success factors.

Based on the questionnaire results, it can be concluded that the students of the University of Sopron are open to sustainability as well as to the university's sustainability activities and goals. Significant differences in openness can be observed among individual students. Our research also highlighted that there is no strong correlation between confidence in sustainability and actual knowledge. Students who are open to the topic are willing to expand their knowledge in various ways (e.g., attending student sustainability events, credit-bearing courses, etc.).

All of these clearly indicate that the university needs to increase its awareness-raising activities to deepen sustainability commitment and reach a broader range of students. It is also recommended to involve students more actively in shaping the institution's sustainability policies.

According to the responses, selective waste collection is identified by students as the sustainability effort most associated with the university, followed by energy management and water management topics. ESG—as one of today's prominent sustainability frameworks and perspectives—is not yet deeply present in students' knowledge. Similarly, awareness of the UN's 17 Sustainable Development Goals remains low.

Based on our research, we can offer concrete suggestions for developing the university's sustainable mobility policy. Student responses clearly show that a primary consideration for them is reducing mobility through conscious timetable planning. Additionally, many would find a university-supported public transport pass system useful and would make use of it. There is also demand for establishing a bicycle and scooter sharing system.

The research clearly demonstrated that university trails play a significant role as both practical and pedagogical tools in shaping students' sustainability mindset. Bridging the gap

between practical experience and theoretical knowledge, fostering community involvement, promoting health preservation, and connecting educational innovation make this tool particularly valuable. The study not only documents existing best practices but also contributes to their further development, broader application, and scientific substantiation.

Acknowledgment

The authors gratefully thank Gergő Bogáti and Babett Heil-Lacsnyi for their contributions to graphical issues.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Authors Contribution

All authors contributed substantially to the work. **A.P.** developed the research concept, designed the methodology, supervised the entire research process, and defined the professional content of both the nature trail and the questionnaire. **V.E.F.** carried out the data collection and contributed to the institutional interpretation of sustainability aspects as well as to the professional description of the nature trail stations. **A.N.** provided expert support for the elaboration of the natural science and forestry background. **D.N.** participated in the data collection and contributed to the interpretation of the results related to student attitudes. **M.T.** was responsible for preparing the data analysis and developing the visual elements. **Á.Ő.** contributed to the fieldwork activities. **E.P.** played a role in defining the frameworks of educational development and institutional sustainability. **F.L.** provided the scientific background for the research and contributed to the conceptual framework of sustainability. **A.F.** offered strategic supervision of the university's sustainability programs and provided support for the implementation of the research. All authors reviewed and approved the final version of the manuscript.

References

1. Whitley J, McConnell L, Williamson K. Development of the Sustainability Attitudes in Education (SAE) Survey. Sustainability. 2018;10(2):445.
2. Concina I, Frate S. Students and the sustainability issue: A systematic literature review. Journal of Cleaner Production. 2023;408:137136.
3. Dawodu A, Bakar NA, Othman MK. Determinants of sustainability practices adoption among universities. Cleaner Engineering and Technology. 2022;9:100511.
4. Leal Filho W, Azeiteiro U, Alves F, Ojha P, Setti M, de Sousa LO. Students' views on climate change and sustainability. Environment, Development and Sustainability. 2023;25(1):661-681.
5. Aikowe OI, Mazancova J. Assessment of the level of knowledge in sustainable development among university students in Nigeria. Sustainability Science. 2023;18(1):177-194.
6. McCormick AK, Matocha CJ, Fairman R, Anderson J. Student commitment to sustainability: A three-year study of behavioral change at a Midwestern university. Sustainability. 2015;7(11):14714-14733.
7. Ando K, Yamaguchi T, Managi, S. Awareness of the sustainable development goals among university students. Sustainability Science. 2019;14:1073-1080.

8. Aleixo AM, Leal Filho W, Azeiteiro UM, Teixeira ML. Climate change and sustainability: students' awareness and perceptions in a Portuguese university. International Journal of Sustainability in Higher Education. 2021;22(1):157-173.
9. Janmaimool P, Khajohnmanee S. Effects of a sustainability course on knowledge, attitude, and behavior of undergraduate students. International Journal of Sustainability in Higher Education. 2019;20(1):126-140.
10. Ahamad MH, Ariffin NM. Pro-environmental attitude and consumption patterns: The dilemma of low self-control. International Journal of Consumer Studies. 2018;42(6):619-629.
11. Ovais M. Pro-environmental knowledge and behavior among university students: The mediating role of self-control. Behavioral Sciences. 2023;13(6):488.
12. Teather K, Etzion D. The knowledge-action gap in environmental behavior: A systematic review of the literature and directions for future research. Frontiers in Psychology. 2023;14:1109783.
13. Nagy B. A fenntarthatóság szempontjai egy felsőoktatási intézményben hallgatói megközelítésből. REALSTUDIA. 2023;13(1):127-142.
14. Ribeiro JLD, Ferreira FAF, Kruglianskas I. Factors influencing the environmental sensitivity of university students. Journal of Cleaner Production. 2021;286:124951.
15. Lukács R, Székely M, Kovács Z. A fenntartható fogyasztás pszichológiai tényezői egyetemi hallgatók körében. Alkalmazott Pszichológia. 2022;22(1):7-30.
16. Haigh M, Griffiths M. The ecological, carbon and water footprints of higher education institutions: Tool, trends and driving forces. International Journal of Sustainability in Higher Education. 2009;10(1):21-35.
17. AL-Mulali U, Tang CF, Ozturk I. Evaluating the environmental research performance of universities in the top European countries: A novel composite index approach. Ecological Indicators. 2015;48:174-182.
18. Bartosh J. How UWM's campus helps students connect with nature. University School of Milwaukee [Internet]; 2023. Available from: https://www.usm.org/news/how-uwm-s-campus-helps-students-connect-nature
19. Gesler WM. The spirit of place and sense of being in western North Carolina. University of North Carolina at Chapel Hill; 1994.
20. Sandell K, Svanberg I. University students' experiences of place and nature during a field course. Journal of Adventure Education and Outdoor Learning. 2016;16(3):228-242.
21. Berman MG, Kross E, Berman V, Ellison S, Su Y, Raskin J. Interacting with nature improves cognition and affect in urban residents. Journal of Environmental Psychology. 2012;32(3):295-303.
22. Kolb, D. A. Experiential learning: Experience as the source of learning and development. Englewood Cliffs, NJ: Prentice Hall; 1984.
23. Bleicher RE. Revisiting and extending the concept of learning cycle. Journal of Research in Science Teaching. 1994;31(4):389-407.
24. TTU Today. (n.d.). Outdoor Learning Center. Texas Tech University [Internet]. Available from: https://today.ttu.edu/posts/2021/09/stories/outdoor-learning-center
25. Orr, D. W. Earth in mind: On education, environment, and the human prospect. Cavelo, California: Island Press; 1994.
26. Pannon Egyetem. (n.d.). Zöld kampusz. Pannon Egyetem [Internet]. Available from: https://zek.uni-pannon.hu/hu/kutatas-fejlesztes/fenntarthatosag-2/zold-kampusz.html
27. Cornell University. (n.d.). Sustainable Landscape Trail. Cornell University [Internet]. Available from: https://sustainablecampus.cornell.edu/get-involved/tours/sustainable-landscape-trail
28. Ulrich RS, Simons RF, Losito BD, Fiorito E, Miles MA, Zelson M. Stress recovery during exposure to natural and urban environments. Journal of Environmental Psychology. 1991;11(3):201-230.

29. Hartig T, Mitchell R, de Vries S, Frumkin H. Nature and health. Annual review of public health. 2014;35:207-228.
30. Warburton DER, Nicol CW, Bredin SSD. Health benefits of physical activity: the evidence. Canadian Medical Association Journal. 2006;174(6):801-809.
31. SUNY Oswego. (n.d.). Rice Creek Field Station. SUNY Oswego [Internet]. Available from: https://www.oswego.edu/rice-creek
32. Sandell K, Svanberg I. Learning, culture and encounters in outdoor environments. Environmental Education Research. 2015;21(6):873-887.
33. Berkshire Community College. (n.d.). John Lambert Nature Trail. Berkshire Community College [Internet]. Available from: https://www.berkshirecc.edu/about/john-lambert-nature-trail/
34. Faber Taylor A, Kuo M, Spencer RC, Wiley A. Views of nature and self-discipline: Evidence from inner city children. Journal of Environmental Psychology. 2002;22(1-2):49-63.
35. Moore RC, Wong HH. Natural learning: Rediscovering nature's way of teaching. Berkeley, CA: MIG Communications; 1997.
36. Doyle ME, Straus K. How to make meetings work: The new interaction method. New York: John Wyden Books; 1976.
37. Arnheim R. Art and visual perception: A psychology of the creative eye. Univ of California Press; 1974.
38. Thackray R, Pheasant S. The use of virtual reality in environmental design. Ergonomics. 2003;46(8):761-777.
39. Soproni Egyetem. Zöld Egyetem. Soproni Egyetem [Internet]; 2025. Available from; https://greenuniversity.uni-sopron.hu/labels-sustainability
40. Soproni Egyetem. A Soproni Egyetem épületgépészeti rendszereinek biomassza hőtermelés alapú ellátásának kiépítése [Internet]; 2023. Available from: https://greenuniversity.uni-sopron.hu/soproni-egyetem-biomassza-hotermeles
41. Sonetti G, Sarrica M, Norton LS. Conceptualization of sustainability among students, administrative and teaching staff of a university community: An exploratory study in Italy. Journal of Cleaner Production. 2021;316:128292.
42. Wu K, Ye X, Jamonnak S, Feng X. A Digital Twin-Driven Recommendation System for Adaptive Campus Course Timetabling. arXiv preprint arXiv. 2025;2503.06109.
43. Dede C. Immersive interfaces for engagement and learning: Virtual worlds, gaming, and simulated environments. Emerging technologies for learning. 2009;1:3-22.