



## GreenTeach: Advancing Vocational Education through a Sustainability-Driven Curriculum

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### Abstract

*The paper intends to explore the critical role of vocational education and training (VET) in fostering sustainable development and equipping learners with the skills necessary for green and digital transitions. It presents the GreenTeach Erasmus Plus project (Code 2024-1-BG01-KA220-VET-00024643), a comprehensive framework designed to integrate sustainability into VET curricula, aligning with environmental stewardship and resource efficiency principles.*

*The GreenTeach approach emphasizes a whole-institutional strategy, addressing five key dimensions: training, teachers, stakeholders, funding, and strategy. GreenTeach ensures learners acquire technical knowledge and transversal skills, such as critical thinking and problem-solving, essential for sustainable practices by greening curricula and training programs. The initiative also highlights the pivotal role of teacher professional development in delivering high-quality green education, fostering a mindset shift among educators and students alike.*

*Collaboration with stakeholders, including industry partners and policymakers, is central to GreenTeach, ensuring alignment with Bulgaria, Italy, Turkey, and Romania's regional and national green policies. The framework also addresses the strategic challenges of implementing green initiatives, offering actionable recommendations for VET institutions to effectively develop and monitor greening strategies.*

*Drawing on case studies and peer reviews, this paper demonstrates how GreenTeach supports the transition to a sustainable economy, particularly in key sectors such as construction and energy. The initiative's structured approach to policy advice and practice sharing underscores its potential to drive systemic change within VET systems.*

*In this framework, GreenTeach represents a transformative model for integrating sustainability into vocational education, empowering learners to contribute to a greener future. By fostering collaboration, innovation, and capacity building, this initiative sets a benchmark for excellence in green VET, aligning with global sustainability goals and the evolving demands of the labour market.*

**Keywords:** Green Skills, Teacher Professional Development, Sustainability-Driven Curriculum, Vocational Education and Training (VET)

### 1. Introduction

Sustainable development and the ecological and digital transitions represent critical challenges for contemporary society. Addressing these shifts requires a skilled workforce capable of integrating environmentally responsible practices and technological advancements into various sectors [1]. Vocational education and training (VET) play a crucial role in this process, as it fosters green skills that support sustainable resource management, energy efficiency, and circular economy models [2]. At the same time, VET strengthens digital literacy, equipping individuals with the expertise to leverage innovative technologies like AI and IoT for sustainable solutions [3]. Recognized by policymakers and institutions such as the European Commission, VET is integral to ensuring workforce adaptability, lifelong learning, and economic resilience in response to the evolving demands of sustainability and digitalization [4].

In this context, vocational education and training (VET) plays a fundamental role in equipping students with the skills needed to face these transformations and contribute to a more sustainable future. Educational institutions play a pivotal role in advancing sustainability by equipping students with the skills and knowledge necessary to tackle environmental challenges [5]. In alignment with initiatives such as the European Green Deal [6], universities and vocational training centers are integrating green education into their curricula to foster a generation of environmentally conscious professionals.

The European University Association (EUA) has developed a Green Deal roadmap for universities to guide institutions in embedding sustainability into their research, teaching, and operational strategies



[7]. Additionally, the EUA survey on greening in higher education highlights how universities across Europe are actively implementing sustainability measures and contributing to the green transition [8].

The European Education Area emphasizes the importance of green education, encouraging schools and universities to integrate climate literacy and sustainability competencies into their programs [9]. Research also underscores the growing academic focus on education for sustainable development, with bibliometric analyses revealing an increase in scholarly output on sustainability education [10]. Furthermore, studies on the impact of higher education institutions on sustainable development provide a conceptual framework for understanding how universities influence environmental, social, and economic sustainability [11].

By embedding sustainability into education, institutions ensure that future generations are equipped to address climate change, resource management, and ecological preservation, reinforcing the broader objectives of the European Green Deal [6].

In line with the above, the Erasmus Plus GreenTeach Project (Code 2024-1-BG01-KA220-VET-00024643) serves as a comprehensive framework aimed at integrating sustainability into VET curricula, aligning with principles of environmental management and resource efficiency. The initiative seeks to strengthen the ecological and sustainability competencies of VET educators, in accordance with the European sustainability competence framework, "GreenComp" [12]. This effort is supported by in-depth research conducted in Bulgaria, Italy, Romania, and Turkey, using a mixed qualitative and quantitative methodology that included document analysis and interviews with VET experts.

Collaboration with stakeholders, including industry partners and policymakers, is a central element of the GreenTeach project, ensuring alignment with regional and national environmental policies in Bulgaria, Italy, Turkey, and Romania. This alignment also draws on guiding documents such as the *2023 Green Skills 4 VET Guidelines* [13]. The project addresses strategic challenges related to implementing green initiatives in VET, offering concrete recommendations to institutions.

Through case studies and peer reviews, GreenTeach demonstrates how to support the transition toward a sustainable economy, with particular focus on key sectors such as construction and energy. It also references the *Green Skills at Vocational Education* project by CEIPES (2022) [14]. The project's structured approach to policy advising and the sharing of best practices highlights its potential to drive systemic change in VET systems.

The research behind the project revealed a growing awareness of the importance of sustainability in VET and the willingness of educators to promote related skills in students. However, a gap emerged between this interest and educators' confidence or familiarity in implementing such topics. A significant portion of teachers showed limited familiarity with the GreenComp framework and sustainability standards. These findings highlight the critical need for structured professional development, clearer guidance, and accessible resources to enable educators to effectively integrate sustainability skills in line with the GreenComp framework.

The work builds on the initial findings of the GreenTeach project by presenting the analysis of the training needs assessment results for VET teachers in the participating countries and offers recommendations for developing competence pathways in environmental protection and the green economy.

## **1.2 The Methodology Used**

The research underpinning the GreenTeach project employed a mixed-methods approach, combining qualitative and quantitative components to explore the integration of green and sustainability competences into Vocational Education and Training (VET). This multifaceted methodology was applied across the four partner countries: Bulgaria, Italy, Romania, and Turkey.

### **1.2.1 Qualitative Research Phase**

The first phase consisted of in-depth desk research, involving the analysis of strategic documents, educational guidelines, policy papers, VET curricula, and publications or reports related to government initiatives. The goal was to systematise existing national and international experiences and outcomes, identify key challenges and areas for improvement in the integration of sustainability into VET, and align the project's activities with existing policy frameworks.

To enrich these findings and obtain practical insights, semi-structured interviews were conducted with 20 VET experts from a diverse range of institutions, including government departments, training centres, schools, colleges, foundations, and environmental organisations delivering vocational programs. These experts brought backgrounds in environmental education, renewable energy, circular



economy, and policy development. The interviews followed a predefined set of key questions, collaboratively developed by the project partners to systematically collect perspectives, opinions, and reflections on core issues for effectively embedding sustainability into VET curricula. Participants provided informed consent, and their data were used solely for research purposes.

### **1.2.2 Quantitative Research Phase**

The quantitative component was implemented through a structured online questionnaire administered to VET teachers in the four participating countries. The primary aim was to assess teachers' training needs regarding sustainability competences and green skills. Specifically, the questionnaire aimed to:

- Evaluate teachers' awareness and understanding of sustainability frameworks, particularly the European Sustainability Competence Framework (GreenComp).
- Measure their confidence in applying various pedagogical methodologies relevant to sustainability education.
- Assess their digital skills and the use of technology in developing sustainability-related educational resources.
- Identify their training needs and preferences for professional development in sustainability education.
- Collect additional suggestions and comments on their professional development needs.

The questionnaire was organized into six distinct sections covering demographic information, awareness of sustainability frameworks, teaching methodologies, digital competencies, training needs, and open comments. It employed a mix of question types, including multiple-choice, short answer, linear scales, and checkboxes.

### **1.3 The findings and Results Discussion**

The findings of the GreenTeach research provide a detailed overview of the integration of sustainability into Vocational Education and Training (VET) in the partner countries (Bulgaria, Italy, Romania, and Turkey). The qualitative analysis, derived from desk research and interviews with 20 VET experts, revealed a growing awareness of the importance of green skills and sustainability in VET, in alignment with both European and national directives. However, the experts highlighted significant challenges, including the need to modernize VET curricula, a lack of specific teacher training, insufficient resources, and the need for closer alignment with the industrial sector. The qualitative recommendations emphasised the importance of advanced teacher training, the adoption of interactive and experience-based teaching methodologies, and stronger collaboration with industry stakeholders. The investigations also pointed out that, although progress has been made, the scope and continuity of sustainability initiatives may still be limited, with notable gaps in knowledge of European and international sustainability standards in certain areas, particularly in Bulgaria.

In parallel, the quantitative results from the online questionnaire administered to 204 VET teachers provided specific data supporting the qualitative framework. The demographic profile of the teachers shows a predominantly mature and experienced group (most aged between 35–54, with many having over 20 years of experience), with a female majority in several countries (Italy 80.6%, Bulgaria 68%, Romania 86.1%, Turkey 51.6%). Most teachers reported integrating sustainability-related topics into their teaching (79.41% in total, with 28.91% doing so regularly and 50.50% occasionally), and there is strong and widespread consensus on the crucial importance of embedding sustainability competences in VET curricula.

Despite this, familiarity with the GreenComp framework is generally low (only 12.26% are very familiar and 1.08% extremely familiar, while 38.89% are moderately familiar, 23.53% slightly familiar, and 18.55% not familiar at all). Confidence in applying GreenComp's key competences is moderate (38.24% moderately confident, but 15.69% not confident and 12.25% not confident at all). Familiarity with international green standards (e.g., ISO 14001, EMAS, SDGs) is also relatively low (27.4% moderately familiar, 12.3% very familiar, but 34.8% slightly familiar and 24.5% not familiar).

Teachers expressed interest in developing learning pathways for specific GreenComp competences but also admitted insufficient familiarity with many of the key concepts. In terms of teaching methodologies, there is greater confidence in established approaches like Inquiry-Based Learning and Experiential Learning, while more innovative methods such as Design Thinking and Microlearning are less known and applied. Methods such as Project-Based Learning, Inquiry-Based Learning, Experiential Learning, Case Studies, and Field Trips are considered the most effective for teaching sustainability.



A critical finding is that the vast majority of teachers have not received formal training in these modern methodologies (e.g., 88.9% in Romania), despite showing strong willingness to participate in training to improve their practices (Italy 91.7%, Bulgaria 96.8%, Romania 97.2%, Turkey 75.8%). Interest in digital training on sustainability is also high (Italy 91.7%, Bulgaria over 95%, Romania 91.7%, Turkey 93.9%), though confidence in using digital tools to create educational resources varies (Italy: 38.89% moderately confident, but 20.83% with low confidence; Bulgaria: nearly 50% confident/very confident; Romania: 75% report using digital tools well or very well).

Preferred training formats include blended or online approaches (blended learning favored in Italy 43.1%, Bulgaria 52.4%, Romania 52.8%; online courses favored in Italy 41.7%, Bulgaria 50.8%), along with in-person workshops, which are strongly preferred in Turkey (66.7%) and significantly in Romania (56.6%).

Among the top priorities for professional development are: strengthening ties with industry, curricular integration, use of digital tools, and understanding/applying the GreenComp framework. In summary, the collected data confirm the perceived importance of sustainability but highlight a clear gap in competences and training among VET teachers, pointing to the urgent need for targeted professional development interventions.

#### **1.4 Conclusion**

The GreenTeach research findings provide a nuanced and evidence-based understanding of the current state of sustainability integration within Vocational Education and Training (VET) across the partner countries—Bulgaria, Italy, Romania, and Turkey. The results affirm the widespread recognition among VET educators of the urgent relevance of sustainability and green skills in contemporary education, aligned with the European Green Deal and national transition strategies. There is clear motivation and willingness among teachers to incorporate sustainability topics into their curricula, with the majority already engaging with these themes to some extent in their classrooms.

Despite this encouraging commitment, the study reveals several critical shortcomings that pose significant barriers to effective implementation. First, there is a limited awareness and understanding of key reference frameworks such as the European sustainability competence framework (GreenComp), as well as low familiarity with international sustainability standards (e.g., ISO 14001, EMAS, SDGs). Secondly, many VET educators report only moderate confidence in teaching sustainability-related content and acknowledge a gap in their knowledge of foundational and advanced sustainability concepts.

Moreover, the research points to a lack of exposure to, and training in, innovative pedagogical methodologies that are particularly suited for sustainability education, such as Design Thinking, Microlearning, and Experiential or Project-Based Learning. While some of these methods are recognized as effective, most teachers have not received formal training in how to apply them, despite expressing strong interest in doing so. The overwhelming majority of respondents across all partner countries emphasized the need for structured, high-quality professional development opportunities to help them build competence in both sustainability content and teaching strategies.

The digital dimension of sustainability education also emerged as a key area requiring support. Although there is high interest in using digital tools to create sustainability-related learning resources, educators' confidence in doing so is uneven, and access to targeted training is often limited. Preferences for training formats vary, but there is significant support for blended and online learning options, complemented by in-person workshops—particularly in Turkey and Romania.

Overall, the data collected through document analysis, expert interviews, and teacher surveys converge to highlight a consistent pattern: VET educators are willing and increasingly aware of the importance of sustainability, but they lack the structured support, resources, and professional learning opportunities needed to act on this awareness in a confident and pedagogically effective way. The findings suggest a pressing need for institutional and policy-level responses that provide VET teachers with:

- Access to structured professional development aligned with GreenComp and sectoral sustainability standards.
- Practical, evidence-based pedagogical resources tailored to the VET context.
- Opportunities for collaboration with industry and sustainability experts.
- Guidance on embedding sustainability into VET curricula in ways that are contextually relevant and labour-market aligned.

These conclusions strengthen the rationale for targeted professional development interventions and strategic investments in teacher capacity building. As the GreenTeach project moves into its next



phases, these research outcomes will serve as a solid foundation for the co-creation of innovative, scalable, and evidence-informed training solutions. The goal is not only to empower VET educators with the skills they need but also to foster a broader transformation of vocational education systems toward greener, more inclusive, and future-ready learning environments.

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