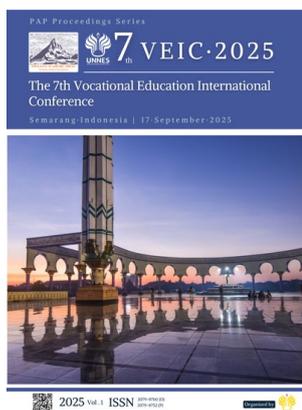


Review **Open Access**

The 7th Vocational Education International Conference (VEIC 2025)

Sustainability Competencies in Beauty-Focused Vocational Programs: Pedagogical Strategies and Industry Expectations - A Systematic Literature Review

Delta Apriyani ^{1,2}, Lilis Widaningsih ^{1,*} and Sudjani Sudjani ¹



¹ Universitas Pendidikan Indonesia, Bandung, Indonesia

² Universitas Negeri Semarang, Semarang, Indonesia

* Correspondence: Lilis Widaningsih, Universitas Pendidikan Indonesia, Bandung, Indonesia

Abstract: The integration of sustainability competencies into vocational education programs has become increasingly critical as industries worldwide shift toward environmentally conscious practices. Beauty-focused vocational programs, which encompass sectors such as cosmetology, skincare, and personal care services, face unique challenges in incorporating green education principles while meeting industry expectations for skilled professionals. This systematic literature review examines the current state of sustainability competencies in beauty-focused vocational programs, evaluates pedagogical strategies employed to develop these competencies, and analyzes industry expectations for sustainable practices among graduates. Following PRISMA guidelines, a comprehensive search was conducted across academic databases, including Scopus, for articles published between 2020-2025. Keywords included "green education," "sustainable education," "education for sustainable development," combined with "TVET," "vocational education," and "technical and vocational education and training." The initial search yielded 70 articles, which were systematically screened and filtered to 17 articles that met the inclusion criteria. The review identified three key themes: (1) emerging sustainability competencies required in beauty-focused vocational programs, including environmental awareness, sustainable product knowledge, and waste reduction practices; (2) innovative pedagogical strategies such as project-based learning, experiential learning, and industry partnerships; and (3) evolving industry expectations for graduates who can balance aesthetic excellence with environmental responsibility. While progress has been made in integrating sustainability into vocational education, significant gaps remain in beauty-focused programs. The findings suggest a need for more systematic integration of green competencies, enhanced industry-education partnerships, and development of specialized curricula that address the unique sustainability challenges of the beauty industry.

Keywords: sustainability competencies; vocational education; TVET; green education; beauty industry; pedagogical strategies

Received: 03 November 2025

Revised: 24 November 2025

Accepted: 23 December 2025

Published: 27 December 2025



Copyright: © 2025 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

In the face of mounting global challenges, including environmental degradation, social inequity, and unsustainable consumption patterns, education has emerged as a transformative force capable of equipping individuals and societies with the tools to

navigate uncertainty and drive change [1]. The concept of sustainable development, once primarily associated with environmental policy, has become deeply interwoven with the very fabric of educational discourse [2]. Education for Sustainable Development (ESD) reflects a paradigm shift in the role of education: from knowledge transmission toward the cultivation of competencies that empower learners to engage critically, act responsibly, and contribute meaningfully to a more equitable and sustainable future [3]. As global attention intensifies on the implementation of the United Nations Sustainable Development Goals (SDGs), particularly SDG 4.7, there is growing consensus that ESD should not be confined to formal education or theoretical frameworks, but rather embedded across learning environments, including technical and vocational education and training (TVET) [4].

TVET occupies a crucial space in the sustainable development agenda [5]. TVET systems are designed to establish a strong education employment linkage by equipping individuals with labor market-relevant skills and creating structural mechanisms that align learning outcomes with workforce needs [6]. Yet, in recent years, TVET has been called upon to go beyond its traditional function as a skills provider and to assume a more expansive role as a vehicle for social transformation and environmental stewardship. Integrating sustainability into vocational programs ensures that graduates are not only job-ready but also equipped to respond to complex socio-ecological challenges, innovate within their industries, and uphold ethical and sustainable practices. In this regard, ESD within TVET must be holistic, targeting knowledge, skills, values, and attitudes, and contextual, aligning with the realities of specific sectors, cultural norms, and local economies [7].

Among the diverse sectors encompassed by vocational education, the beauty industry offers a particularly compelling context for exploring sustainability integration. Globally, the beauty and personal care sector has experienced exponential growth, driven by expanding consumer markets, digital marketing, and the pursuit of wellness and self-expression [8,9]. However, this growth has also raised critical concerns about the industry's ecological footprint, including excessive packaging waste, overconsumption of water and energy, the use of hazardous chemicals, and opaque supply chains [10,11]. As consumers become more informed and value-driven, there is increasing pressure on beauty brands and practitioners to adopt environmentally and socially responsible practices. This evolution has direct implications for vocational education: beauty schools and training programs must reconsider how they define professionalism, what values they instill in students, and how they align their curricula with the broader goals of sustainable development.

Beauty-focused vocational education occupies a unique intersection between art, science, commerce, and well-being. Unlike other TVET domains that may be more technical or engineering-based, beauty education involves tactile skills, interpersonal communication, emotional labor, aesthetic judgment, and customer service, all of which are deeply embedded in social and cultural contexts [12,13]. The shift toward sustainability, therefore, cannot rely solely on technical substitution (e.g., using eco-friendly products) but must involve a deeper pedagogical reorientation [14,15]. Educators must engage students in critical thinking about the consequences of their practices, cultivate environmental awareness, and foster ethical sensibilities [16,17]. This demands not only a revision of curricular content but also a transformation in pedagogical approaches, institutional culture, and teacher capacities [18-20].

Yet, despite its potential and urgency, the incorporation of ESD in beauty education remains fraught with challenges. In many countries, vocational institutions still operate with outdated curricula that prioritize industry compliance over critical reflection or innovation [21,22]. Educators often lack access to sustainability-focused professional development or instructional resources [23,24]. Infrastructure and facilities may be insufficient to support practical learning that aligns with sustainable principles [25,26]. Furthermore, there is often a misalignment between what is taught in classrooms and the

expectations of contemporary green-oriented beauty businesses. The result is a skills mismatch that may limit graduates' employability in a sector that is rapidly evolving toward eco-conscious branding, ethical certification, and sustainable entrepreneurship [27].

At the same time, this gap between current practices and sustainability aspirations represents an opportunity for transformation. The beauty industry's ongoing shift toward circular economy models, low-impact production, and transparency in sourcing creates fertile ground for educational innovation. New pedagogical models such as project-based learning, simulation-based training, co-creation with industry, and digital storytelling offer promising pathways for embedding sustainability into beauty training [28]. Moreover, international best practices demonstrate that whole-institution approaches, participatory governance, and community engagement can foster institutional cultures of sustainability that extend beyond the classroom. For beauty education, this means reimagining the salon or spa not just as a site of service delivery, but as a living laboratory where sustainability is practiced, modeled, and assessed.

While a growing body of research has emerged around sustainability in TVET, much of it concentrates on sectors like agriculture, energy, or manufacturing. Comparatively little attention has been paid to the beauty sector, despite its global scale and significant cultural and economic influence. The limited studies that do address sustainability in beauty education often focus narrowly on environmental practices, without examining broader pedagogical frameworks or linking educational strategies to industry expectations. Moreover, there is a lack of synthesis that connects the three pillars necessary for effective sustainability integration: (1) the identification and development of relevant sustainability competencies, (2) the pedagogical methods and institutional strategies used to foster these competencies, and (3) the alignment of educational outcomes with the labor market demands and ethical imperatives of the beauty industry.

To address these gaps, this study conducts a systematic literature review of sustainability competencies in beauty-focused vocational education. It combines traditional thematic analysis with bibliometric techniques, employing the PRISMA framework and Systematic Literature Network Analysis (SLNA) using VOSviewer software. The purpose is not only to catalog what has been done, but to visualize conceptual linkages, identify emerging trends, and uncover underexplored areas. Through this approach, the study provides a comprehensive overview of the state of the art, while also offering actionable insights for curriculum development, pedagogical innovation, and industry–education collaboration.

The contributions of this paper are multidimensional. First, it advances theoretical understanding by articulating how sustainability is being defined, operationalized, and taught within beauty vocational programs. Second, it contributes methodologically by integrating bibliometric mapping with qualitative synthesis, offering a replicable approach for similar sector-specific reviews. Third, it supports practical application by informing educators, policymakers, and beauty industry stakeholders about the competencies, pedagogies, and partnerships needed to prepare graduates for a sustainable future. Lastly, it aligns with global and national policy priorities that call for a greener TVET system one that does not merely supply labor, but actively shapes the ethical, environmental, and economic trajectory of industries like beauty.

To guide the analysis and ensure coherence across findings, the study is structured around three central research questions:

- 1) What sustainability competencies are being developed within beauty-focused vocational education programs?
- 2) What pedagogical strategies are employed to cultivate sustainability literacy in vocational beauty training?
- 3) What expectations does the beauty industry have regarding the sustainability competencies of vocational education graduates?

Unlike previous studies that focus on general technical or agricultural TVET sectors, this study provides a systematic synthesis of sustainability integration in the underexplored domain of beauty-focused vocational education. This unique focus allows the study to uncover sector-specific gaps, competencies, and opportunities, thereby contributing novel insights to the literature on Education for Sustainable Development (ESD) in service-oriented vocational training.

2. Materials and Methods

2.1. Search Strategy and Information Sources

This systematic literature review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and reproducibility. PRISMA enhances transparency, minimizes selection bias, and facilitates evidence-based decision-making, making it valuable for policy-driven fields such as sustainable education site selection and MCDM applications.

A comprehensive literature search was conducted using the Scopus database, which provides extensive coverage of peer-reviewed academic literature in education, sustainability, and vocational training fields [29]. The search strategy employed a combination of terms related to sustainability education and vocational training: ("green education" OR "sustainable education" OR "education for sustainable development") AND (TVET OR "vocational education" OR "technical and vocational education and training").

The keyword selection was carefully designed to ensure relevant yet comprehensive literature coverage. The inclusion of "green education" and "sustainability competencies" along with their equivalents, such as "TVET" and "vocational education," ensures that the search captures studies explicitly discussing the application of sustainability principles in vocational education. This combination balances specificity and inclusiveness, preventing the inclusion of articles that only discuss sustainability in general without direct connection to the beauty field, while ensuring comprehensive coverage of literature evaluating sustainability competencies, pedagogical approaches, and connections to beauty industry needs.

2.2. Eligibility Criteria

The selection of appropriate databases was crucial to ensure that the obtained literature was of high quality and represented comprehensive coverage of existing research. To achieve this, document searches were conducted through academic databases, including Scopus, resulting in 70 articles in the initial search. Inclusion criteria were established to focus on journal articles published between 2020-2025, yielding 41 articles.

The selection of the article time range from 2020 to 2025 was based on the need to capture current and relevant literature that reflects vocational education's response to global sustainability challenges following the endorsement of the SDGs Agenda and post-pandemic developments. The year 2020 was chosen as the starting point because it marked a significant increase in global attention to integrating education for sustainable development into vocational systems, which was also marked by various curriculum reforms in various countries. Additionally, during this period, there was an increase in research linking green education with curriculum development, sustainability competencies, and industry responses to vocational education graduates, especially in the context of digitalization and green transition.

Inclusion Criteria:

- 1) Articles published in peer-reviewed journals
- 2) Written in the English language
- 3) Focus on sustainability education in the vocational/TVET context
- 4) Published between 2020-2025
- 5) Accessible full-text articles

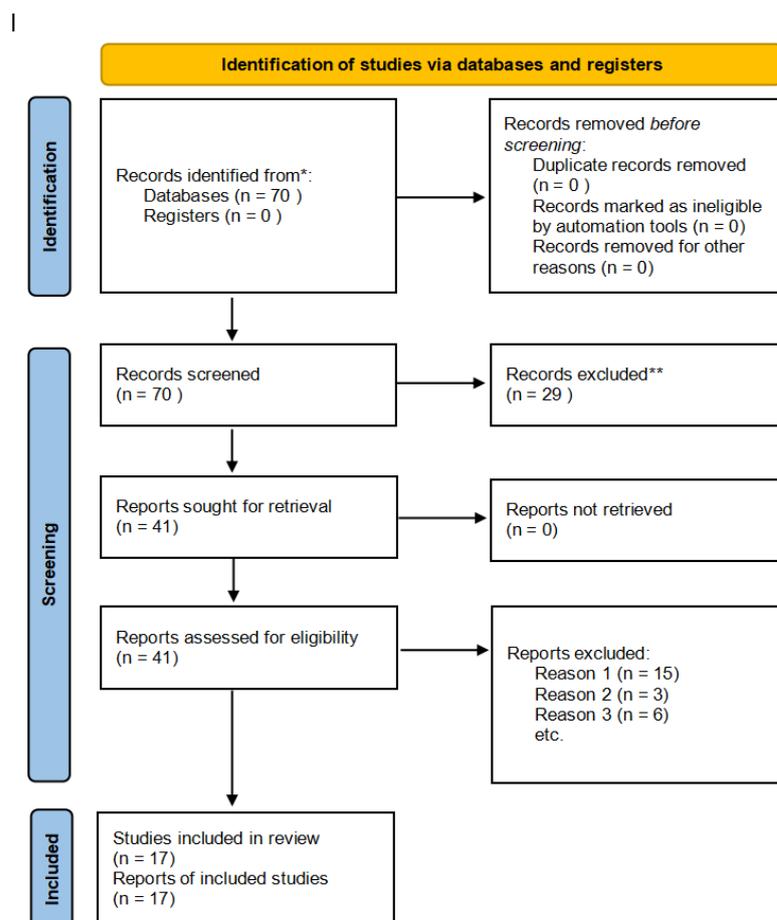
- 6) Original research articles (not review articles, editorials, or opinions)

Exclusion Criteria:

- 1) Articles that are editorials, opinions, or news items
- 2) Studies that focus only on general sustainability without a vocational education connection
- 3) Articles without abstracts or with incomplete data
- 4) Not in the English language
- 5) Studies that do not address aspects of pedagogy, curriculum, or competency development

2.3. Study Selection Process

The study selection process followed a systematic approach as outlined in Figure 1. The initial Scopus search yielded 70 articles. After filtering based on publication year criteria (2020-2025), 41 articles remained. Subsequently, articles were selected based on topic relevance or study scope, resulting in the elimination of 15 articles deemed not substantially relevant to the research focus. Further screening based on document type eliminated 3 articles that did not qualify as original research articles. This resulted in 23 articles progressing to the next stage. However, after checking for full-text availability, 6 articles were found to be unavailable in their entirety.



Source: Page MJ, et al. BMJ 2021;372:n71. doi: 10.1136/bmj.n71.

Figure 1. PRISMA.

The final result yielded 17 articles that met all criteria and were deemed suitable for further analysis in this literature review. By focusing exclusively on peer-reviewed journal articles, this systematic review ensures the inclusion of high-quality and methodologically

sound studies, thereby enhancing the validity, reliability, and robustness of the overall analysis.

2.4. Data Extraction and Analysis

Data extraction was performed using a standardized form designed to capture key information relevant to the research questions. The extraction form included: author details and publication year, study context and participant characteristics, sustainability competencies identified or developed, pedagogical strategies employed, industry expectations or demands mentioned, study design and methodology, and key findings related to the research questions.

Two reviewers independently extracted data from each included study to ensure accuracy and minimize bias. Discrepancies were resolved through discussion, and when necessary, a third reviewer was consulted to reach consensus. A narrative synthesis approach was employed to analyze and present the findings, organizing results according to the three research questions and identifying emerging themes and patterns across studies

2.5. Bibliometric Analysis

To complement the systematic literature review, a bibliometric analysis was conducted using VOSviewer software version 1.6.18 to visualize research trends and thematic clusters in the field of sustainability education within vocational training contexts. The bibliometric analysis included: The analysis was performed on the same dataset of 17 included articles, with keywords extracted from titles, abstracts, and author-provided keywords. A minimum occurrence threshold of 2 was applied to ensure meaningful cluster identification while maintaining comprehensiveness of the analysis.

3. Results

3.1. Study Characteristics

The 17 studies included in this systematic review represent research conducted across multiple geographic regions and educational contexts between 2020 and 2025. The studies encompassed various vocational education settings, from formal TVET institutions to continuing professional development programs, with sample sizes ranging from small-scale case studies (n=28) to large-scale surveys (n=2,985). The research employed diverse methodological approaches, including experimental designs, cross-sectional surveys, qualitative case studies, and mixed-methods approaches.

Geographically, the studies spanned multiple continents, with significant representation from Europe (Germany, Finland, Norway, Bulgaria), Asia (Malaysia, Taiwan, Korea), North America, and Australia. This geographic diversity provides valuable insights into how different cultural, economic, and policy contexts influence the integration of sustainability competencies in vocational education.

3.2. Sustainability Competencies in Beauty-Focused Vocational Programs (RQ1)

The analysis reveals a comprehensive framework of sustainability competencies being developed across beauty-focused vocational programs. Environmental awareness and ecological thinking emerged as foundational competencies, with multiple studies emphasizing the importance of understanding environmental impacts, lifecycle assessment principles, and sustainable resource management. Students are being trained to recognize the environmental consequences of beauty industry practices, from product manufacturing to waste disposal. Sustainable product knowledge and material literacy represents another critical competency area. Programs are increasingly incorporating education about eco-friendly ingredients, sustainable packaging alternatives, and certification systems for green beauty products. Students learn to evaluate and select products based on environmental criteria while maintaining quality standards expected

by clients and employers. Waste reduction and circular economy principles feature prominently in contemporary curricula. Students develop skills in minimizing waste generation, implementing recycling and upcycling practices, and understanding circular business models within the beauty sector. This includes practical training in efficient product usage, proper disposal methods, and innovative approaches to waste minimization.

Energy efficiency and resource conservation competencies focus on operational sustainability within beauty service environments. Students learn to optimize energy usage in salon and spa settings, implement water conservation techniques, and select energy-efficient equipment and technologies. Social responsibility and ethical practice competencies address the social dimensions of sustainability. This includes understanding fair trade principles, ethical sourcing practices, and the social impacts of beauty industry operations on communities and workers throughout the supply chain. Innovation and entrepreneurial thinking for sustainability represent an emerging competency area. Students are encouraged to develop creative solutions to sustainability challenges, explore green business opportunities, and understand the economic benefits of sustainable practices in beauty enterprises.

3.3. Pedagogical Strategies for Sustainability Education (RQ2)

The review identified several innovative pedagogical approaches being employed to develop sustainability competencies in beauty-focused vocational programs. Project-based learning (PBL) emerged as a dominant strategy, with students engaging in real-world sustainability projects that combine theoretical knowledge with practical application. These projects often involve developing sustainable beauty products, designing eco-friendly salon layouts, or creating waste reduction programs for beauty establishments. Experiential learning and hands-on practice represent a cornerstone of effective sustainability education in vocational contexts. Students engage directly with sustainable practices through laboratory work, field experiences, and internships in environmentally conscious beauty businesses. This approach allows students to develop both technical skills and environmental awareness simultaneously.

Industry partnerships and collaborative learning feature prominently in successful programs. Educational institutions are forming strategic alliances with sustainable beauty companies, environmental organizations, and green certification bodies to provide students with authentic learning experiences and current industry insights. Digital integration and virtual learning platforms are being utilized to enhance accessibility to sustainability education resources. Virtual reality simulations, online modules, and digital assessment tools are expanding the reach and effectiveness of sustainability education while reducing the environmental footprint of educational delivery.

Reflective practice and critical thinking development approaches encourage students to examine their own values, assumptions, and practices related to sustainability. Through guided reflection exercises, case study analysis, and peer discussions, students develop a deeper understanding of sustainability principles and their application in professional contexts.

Interdisciplinary integration strategies connect sustainability education with other subject areas, including business management, chemistry, health sciences, and design. This holistic approach helps students understand the multifaceted nature of sustainability challenges and solutions in the beauty industry. Assessment innovation includes the development of new evaluation methods that assess both technical competency and sustainability knowledge. Portfolio-based assessments, practical demonstrations of sustainable practices, and project presentations are replacing traditional testing methods in many programs.

3.4. Industry Expectations and Graduate Preparedness (RQ3)

The analysis reveals evolving industry expectations for sustainability competencies among beauty-focused vocational graduates. Environmental compliance and certification knowledge has become increasingly important, with employers expecting graduates to understand and implement various environmental standards and certification requirements. This includes knowledge of organic and natural product certifications, sustainable business practice standards, and regulatory compliance requirements. Client education and communication skills represent critical expectations from industry employers. Graduates are expected to effectively communicate sustainability benefits to clients, educate consumers about environmentally conscious choices, and promote sustainable practices within their professional interactions.

Innovation and adaptability in sustainable practices are highly valued by progressive beauty industry employers. Companies seek graduates who can contribute to ongoing sustainability initiatives, suggest improvements to existing practices, and adapt to rapidly evolving environmental standards and technologies.

Cost-effectiveness and business acumen in sustainability implementation represent a growing expectation. Employers value graduates who understand the economic benefits of sustainable practices and can implement environmentally conscious approaches that also support business profitability and competitiveness.

However, the review also identified significant gaps between educational preparation and industry needs. Many employers report that graduates lack sufficient practical experience with sustainable technologies and practices. Limited exposure to current industry sustainability trends and insufficient training in emerging green technologies represent key areas where educational programs are not fully meeting industry expectations.

Regional and cultural variations in industry expectations were noted, with different markets placing varying emphasis on specific sustainability competencies. European markets tend to prioritize regulatory compliance and certification knowledge, while Asian markets often emphasize innovation and technological adaptation.

The findings suggest that while substantial progress has been made in developing sustainability competencies within beauty-focused vocational programs, continued evolution is needed to fully align educational outcomes with dynamic industry expectations and environmental challenges.

3.5. Bibliometric Analysis Results

3.5.1. Thematic Clusters and Research Domains

The co-occurrence network analysis revealed distinct thematic clusters that characterize the current research landscape in sustainability education within vocational training contexts (Figure 2). The analysis identified four primary research clusters:

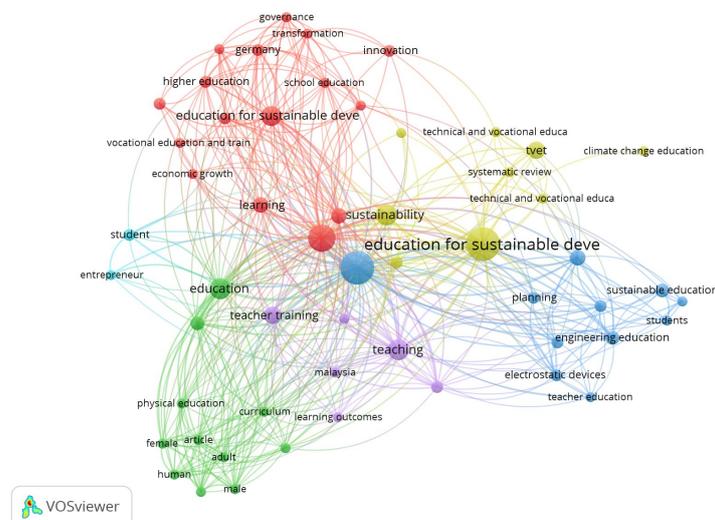


Figure 2. Co-occurrence Network Analysis of Sustainability Education Research.

Red Cluster - Policy and Institutional Transformation: This cluster encompasses keywords related to governance, transformation, innovation, Germany, higher education, and school education. The prominence of this cluster indicates a strong research focus on institutional and policy-level approaches to integrating sustainability in education systems. The inclusion of "Germany" reflects the country's leadership role in sustainability education policy development.

Green Cluster - Pedagogical Approaches and Training: The green cluster centers around education, teacher training, curriculum, physical education, and learning outcomes. This cluster represents research focused on educational methods, teacher preparation, and curriculum development for sustainability education. The connection between teacher training and curriculum development highlights the critical role of educator preparation in successful sustainability integration.

Blue Cluster - Technical and Engineering Education: This cluster includes technical and vocational education, TVET, engineering education, electrostatic devices, and teacher education. The cluster demonstrates the technical dimension of sustainability education, particularly in engineering and technology-focused vocational programs. The presence of specific technical terms suggests research attention to specialized sustainability applications.

Yellow Cluster - Research Methodology and Review Studies: This cluster encompasses systematic review, climate change education, and technical and vocational education components. The cluster indicates methodological research trends and the emergence of evidence-based approaches to understanding sustainability education effectiveness.

3.5.2. Temporal Evolution of Research Themes (2019-2024)

The temporal overlay analysis (Figure 3) reveals significant evolution in research focus over the examined period. Earlier research (2019-2020, shown in blue/green tones) concentrated on fundamental concepts such as "education," "teaching," "learning," and "teacher training," indicating foundational work in establishing sustainability education frameworks.

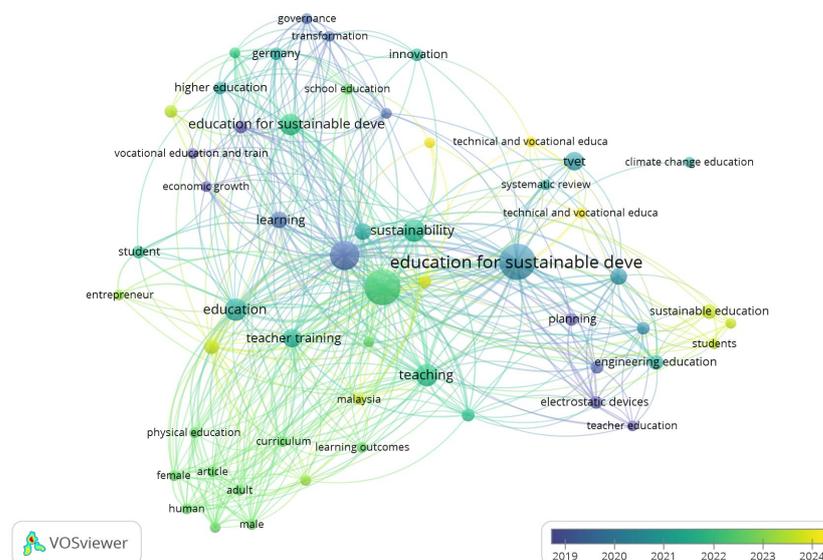


Figure 3. Temporal Overlay of Research Theme Evolution (2019-2024).

Recent Developments (2022-2024): The analysis shows the emergence of more specialized themes in recent years, represented by yellow and light green colors:

- 1) TVET and Technical Education: Increased focus on technical and vocational education and training reflects growing recognition of TVET's critical role in sustainability transitions;
- 2) Systematic Review and Evidence-Based Approaches: The prominence of "systematic review" indicates maturation of the field with emphasis on evidence synthesis and methodological rigor;
- 3) Climate Change Education: Explicit attention to climate change education suggests increasing urgency and specificity in addressing environmental challenges
- 4) Technical and Vocational Education: Reinforced emphasis on vocational contexts demonstrates growing understanding of skilled workforce needs for sustainability transitions

This temporal progression indicates a field evolution from general sustainability education concepts toward more targeted, context-specific, and methodologically sophisticated research approaches.

3.5.3. Central Concepts and Research Integration

The network analysis identifies "education for sustainable development" and "sustainability" as the most central and highly connected concepts, appearing as the largest nodes in the network. These terms serve as intellectual bridges connecting various research themes and approaches. The positioning and size of these nodes indicate their fundamental importance across all research clusters.

Cross-Cluster Connections: The visualization reveals strong interconnections between clusters, suggesting interdisciplinary integration in sustainability education research. Key bridging concepts include:

- 1) "Learning" connects pedagogical approaches with technical education
- 2) "Teacher training" links policy initiatives with practical implementation
- 3) "Students" serves as a focal point connecting various educational approaches and outcomes

3.5.4. Implications for Beauty-Focused Vocational Education

The bibliometric analysis reveals several important implications for beauty-focused vocational education research and practice:

Research Gap Identification: The absence of beauty industry-specific terms in the major clusters confirms the research gap identified in this systematic review. While technical and vocational education receives attention, specialized service industries like beauty remain underrepresented in the literature.

Methodological Trends: The prominence of systematic review approaches suggests opportunities for evidence-based curriculum development in beauty education programs. The field's methodological maturation provides frameworks that can be adapted for beauty-specific contexts.

Integration Opportunities: The strong connections between teacher training, curriculum development, and technical education clusters suggest potential pathways for integrating sustainability competencies into beauty education through comprehensive faculty development and curriculum reform initiatives.

Policy Connections: The policy and institutional transformation cluster indicates the importance of institutional support for sustainability integration, suggesting that beauty education programs require systematic institutional commitment rather than isolated course additions.

Network visualization showing thematic clusters in sustainability education research. Node size indicates frequency of occurrence, while colors represent different thematic clusters. The visualization reveals four main research domains: policy and institutional transformation (red), pedagogical approaches (green), technical education (blue), and research methodology (yellow).

Temporal evolution of research themes in sustainability education from 2019-2024. Earlier themes (blue/green) focus on foundational concepts, while recent developments (yellow/light green) emphasize specialized applications and methodological sophistication. The progression indicates field maturation toward context-specific and evidence-based approaches.

4. Discussion

4.1. Integration of Sustainability Competencies in Beauty-Focused Vocational Education

The analysis of 17 peer-reviewed articles indicates that sustainability is no longer treated as a supplementary element in vocational education, but increasingly regarded as a core professional competency in beauty-focused programs. This marks a paradigm shift from compliance-based environmental awareness to integrated, context-specific skill development that includes ethical reasoning, systems thinking, and social responsibility [30,31].

Several studies demonstrate how sustainability competencies are woven into technical learning through green salon practices, product lifecycle analysis, and environmental risk awareness [32,33]. In particular, the concept of "whole institution approach" has gained traction, fostering sustainability not only in curriculum content but also in the culture, operations, and infrastructure of vocational institutions.

Nevertheless, variability in implementation remains a key challenge. Some institutions embed sustainability across all instructional domains, while others isolate it as a stand-alone module with limited pedagogical integration [34,35]. This fragmentation underscores the need for clear, adaptable frameworks that link sustainability to core beauty competencies across diverse cultural and regulatory settings [36,37].

Moreover, the underrepresentation of beauty-focused programs in ESD research confirms a significant gap in scholarly attention. While several studies address vocational sustainability in agriculture, manufacturing, and digital industries, service-based sectors like beauty remain at the periphery of the discourse highlighting the novelty and relevance of this review [38-41].

4.2. Effectiveness of Pedagogical Strategies

Across the reviewed studies, experiential and learner-centered strategies were most effective in developing sustainability competencies. These include problem-based learning (PBL), project-based learning, and entrepreneurial simulations. These strategies enable learners to engage with real-world sustainability issues while building technical, cognitive, and affective skills.

The integration of digital platforms and mobile-based sustainability tools has also expanded access and flexibility. However, several authors caution that in highly tactile fields like beauty, digital tools must be complemented by hands-on practice using eco-friendly materials and sustainable service protocols [42].

Significantly, industry co-creation in curriculum design was found to increase learner motivation and the relevance of sustainability content. However, success depends on the depth of partnership and industry actors' own understanding of sustainability practices [43,44]. In many cases, faculty members still lack the pedagogical tools and sustainability knowledge to fully implement these methods [45,46].

4.3. Industry-Education Alignment Challenges

Although sustainability trends in the beauty industry are accelerating driven by consumer demand, ethical branding, and regulatory shift vocational education has not kept pace. Employers increasingly seek graduates who understand eco-certifications, ethical sourcing, and sustainable entrepreneurship, yet many curricula still emphasize outdated techniques or focus narrowly on technical performance.

Several studies indicate a lack of practical exposure to sustainability tools such as refill systems, water-saving devices, and green cosmetics. Moreover, assessment systems rarely evaluate sustainability competencies in a comprehensive way, which limits accountability and feedback loops.

Regional disparities also compound the problem. While programs in countries like Finland and Korea show promising integration models, those in developing regions often face infrastructure limitations and weaker policy support. Hence, a localized but globally informed approach is necessary to bridge these gaps.

4.4. Implications for Curriculum Development and Policy

The findings imply that sustainability must be institutionalized across all layers of vocational education. Curriculum development should not only update technical content but also incorporate values-based learning, systems analysis, and interdisciplinary collaboration. This calls for modular and flexible structures that can adapt to technological shifts and sector-specific demands.

Policy-level support is equally vital. Incentives for industry–education partnerships, educator training, and sustainability infrastructure investment will ensure that institutions are not left behind. More importantly, national qualification frameworks must embed sustainability across beauty and service-oriented occupations, not just manufacturing and agriculture.

Moreover, the rising influence of digital transformation in TVET requires policies that promote blended learning while ensuring access to sustainable materials, waste protocols, and physical infrastructure.

4.5. Limitations and Future Research Directions

While this review offers a comprehensive overview, it is not without limitations. First, its scope is restricted to open-access, peer-reviewed journal articles published between 2020–2025, excluding grey literature and non-English studies [45]. Second, the geographic concentration of studies in Europe and Asia limits the extrapolation of findings to other regions with different institutional capacities [43].

Third, few articles conducted longitudinal studies on graduate trajectories or environmental outcomes, which would be essential to assess the long-term impact of sustainability integration [42]. Additionally, assessment tools specific to beauty education remain underdeveloped, hindering competency tracking and curriculum refinement [46].

Future research should address:

- 1) Development of standardized tools to assess sustainability competencies in service-oriented TVET.
- 2) Comparative studies across cultural, regulatory, and institutional contexts to generate best practice models.
- 3) Investigations into educator training and infrastructure barriers, especially in under-resourced beauty institutions.
- 4) Monitoring the adoption of eco-innovation (e.g., low-emission devices, sustainable packaging) in practical training environments. Monitoring the adoption of eco-innovation (e.g., low-emission devices, sustainable packaging) in practical training environments.

Additionally, emerging trends such as AI-enhanced beauty diagnostics, biodegradable tools, and low-impact product innovation require ongoing horizon scanning to ensure that curriculum and pedagogy stay ahead of evolving industry demands.

5. Conclusions

This systematic literature review provides comprehensive insights into the current state and future directions of sustainability competencies in beauty-focused vocational programs. The analysis reveals significant progress in integrating environmental consciousness into traditional beauty education while highlighting persistent challenges in aligning educational outcomes with dynamic industry expectations.

5.1. Key Findings Summary

The review identified a multifaceted framework of sustainability competencies that extends far beyond basic environmental awareness to encompass technical skills, business acumen, and social responsibility. Contemporary beauty-focused vocational programs are increasingly adopting innovative pedagogical strategies that emphasize experiential learning, industry collaboration, and practical application of sustainability principles. However, significant gaps remain between educational preparation and industry requirements, particularly in areas of emerging technology application, regulatory compliance, and sustainable business practice implementation. The effectiveness of different pedagogical approaches varies considerably, with project-based learning and industry partnerships showing particular promise for developing comprehensive sustainability competencies. Digital integration strategies offer opportunities for enhanced accessibility and standardization, though they must be carefully designed to ensure adequate hands-on experience with sustainable practices and technologies.

The bibliometric analysis confirms the relative absence of beauty industry-specific research in the sustainability education literature while revealing methodological trends that can inform future research in this domain. The field's evolution toward evidence-based, context-specific approaches provides a foundation for developing systematic frameworks for beauty-focused sustainability education.

5.2. Implications for Practice

For vocational educators, these findings suggest the need for comprehensive curriculum reform that integrates sustainability principles throughout all aspects of beauty training rather than treating environmental considerations as separate subject matter. The development of robust industry partnerships emerges as crucial for ensuring

graduate preparedness and maintaining curriculum relevance in rapidly evolving professional contexts.

Educational institutions should prioritize faculty development in sustainability principles and pedagogical innovation, ensuring that instructors possess both environmental knowledge and effective teaching strategies for complex, interdisciplinary competencies. Investment in sustainable technologies and materials for hands-on learning experiences is essential for preparing graduates who can immediately contribute to sustainable practice implementation in professional settings.

For policymakers, the findings highlight the need for supportive frameworks that incentivize collaboration between educational institutions and sustainable beauty enterprises. Regulatory standards for sustainability education in vocational programs could help ensure consistent quality and comprehensiveness across different institutions and regions.

5.3. Implications for Industry

Beauty industry employers should consider expanding their engagement with vocational education institutions through internships, guest instruction, curriculum advisory roles, and collaborative research initiatives. Providing educational institutions with access to current sustainable technologies and practices benefits both student learning and industry talent development.

The review suggests that industry expectations for graduate sustainability competencies continue to evolve rapidly, requiring ongoing communication between employers and educators to ensure alignment between training and workplace requirements. Investment in continuing professional development for current employees can complement improved pre-service education in building a sustainability-competent workforce.

5.4. Future Research Priorities

Several research priorities emerge from this review. The development and validation of reliable assessment tools for measuring sustainability competencies in beauty-focused vocational contexts represents an immediate need. Longitudinal studies tracking graduate outcomes and career progression could provide valuable insights into the long-term effectiveness of different educational approaches.

Comparative international research examining how different cultural, economic, and regulatory contexts influence sustainability education approaches would inform the development of globally relevant standards and practices. Additionally, research investigating the environmental and economic impacts of graduates from different types of sustainability-integrated programs could provide evidence of educational effectiveness beyond traditional employment metrics.

The rapid pace of innovation in sustainable beauty technologies and practices necessitates ongoing research to identify emerging competency requirements and evaluate the effectiveness of different pedagogical approaches in preparing graduates for evolving industry demands.

5.5. Final Recommendations

Based on the comprehensive analysis presented in this review, we recommend a coordinated approach to advancing sustainability competencies in beauty-focused vocational education. This includes systematic curriculum integration that weaves sustainability principles throughout all aspects of beauty training, enhanced industry-education partnerships that provide authentic learning experiences and current industry insights, flexible pedagogical approaches that can adapt to rapidly evolving sustainability practices and technologies, and comprehensive assessment frameworks that evaluate both technical competency and sustainability knowledge.

The transformation of beauty-focused vocational education to meet sustainability challenges represents both an opportunity and a responsibility. As the beauty industry continues to evolve toward more environmentally conscious practices, vocational education programs must lead in preparing graduates who can excel professionally while contributing meaningfully to global sustainability goals. The foundations for this transformation are evident in current practice, but sustained commitment, innovation, and collaboration across educational and industry sectors will be essential for realizing the full potential of sustainability-integrated beauty education.

References

1. Dewi, D. E., Winoto, J., Achسانی, N. A., & Suprehatin, S. (2025). Understanding Deep-Seated Paradigms of Unsustainability to Address Global Challenges: A Pathway to Transformative Education for Sustainability. *World*, 6(3), 106. <https://doi.org/10.3390/world6030106>
2. Deriu, F., & Gallo, R. (2024). Sustainable green educational paths in the Italian higher education institutions: A text mining approach. *Sustainability*, 16(13), 5497. <https://doi.org/10.3390/su16135497>
3. Fernando, A. R. R., & Tajan, G. P. (2024). Education for sustainable development (ESD) through participatory research (PR): A systematic review. *Journal of Cleaner Production*, 482, 144237. <https://doi.org/10.1016/j.jclepro.2024.144237>
4. McGrath, S., & Russon, J. A. (2023). TVET SI: Towards sustainable vocational education and training: Thinking beyond the formal. *Southern African Journal of Environmental Education*, 39. <https://doi.org/10.4314/sajee.v39i.03>
5. Manyati, T. K., Kalima, B. G., Owolabi, T., & Mutsau, M. (2024). Exploring the potential for enhancing green skills training, innovation, and sustainable livelihoods in informal spaces of Harare, Zimbabwe: identifying gaps and opportunities. *IIMBG Journal of Sustainable Business and Innovation*, 2(1), 60-79. <https://doi.org/10.1108/IJSBI-06-2023-0036>
6. Caves, K. M., Ghisletta, A., Kemper, J. M., McDonald, P., & Renold, U. (2021). Meeting in the middle: TVET programs' education–employment linkage at different stages of development. *Social Sciences*, 10(6), 220. <https://doi.org/10.3390/socsci10060220>
7. Lenziardi, R., Méxas, M. P., Lucas, M., & Sá, P. (2025). Enhancing teacher competences in education for sustainable development (ESD): A value-oriented framework. *Journal of Teacher Education for Sustainability*, 27(1), 6-32. <https://doi.org/10.2478/jtes-2025-0002>
8. Turcu, O., Brancu, C., Busu, C. (2025). The Beauty Boom: Analyzing the Socio-Economic Contribution of the Beauty Industry to the European Union. In: Busu, M. (eds) *Smart Solutions for a Sustainable Future*. ICBE 2024. Springer Proceedings in Business and Economics. Springer, Cham. https://doi.org/10.1007/978-3-031-78179-7_24
9. Morais, I. C. D., Nascimento, T. C. D., & Tayt-son, D. B. D. C. (2024). Reimagining beauty: Digital consumption practices in a disrupted world. *BAR-Brazilian Administration Review*, 21(suppl 1), e240111. <https://doi.org/10.1590/1807-7692bar2024240111>
10. Pan, H., Wang, R., Wang, H., & Jia, Z. (2023). Sustainable Supply Chain Management: Best Practices for Reducing Environmental Footprints in the Global Apparel Industry. *ESTIDAMAA*, 2023, 18-26. <https://doi.org/10.70470/ESTIDAMAA/2023/003>
11. Glavič, P. (2021). Evolution and current challenges of sustainable consumption and production. *Sustainability*, 13(16), 9379. <https://doi.org/10.3390/su13169379>
12. Vlahos, A., Hartman, A. E., & Ozanne, J. L. (2022). Aesthetic work as cultural competence: chasing beauty in the coproduction of aesthetic services. *Journal of Service Research*, 25(1), 126-142. <https://doi.org/10.1177/10946705211047983>
13. Zhao, Z., & Oh, E. J. (2023). Exploring Methods to Improve the Quality of Beauty Education. *Frontiers in Educational Research*, 6(24). <https://doi.org/10.25236/FER.2023.062419>
14. Bloese, P. (2025). Pedagogical Approaches for Teaching Education for Sustainable Development in the Technology Education Curriculum. *Research in Social Sciences and Technology*, 10(1), 209-232. <https://doi.org/10.46303/ressat.2025.12>
15. Radhakrishnan, S. (2020). Sustainable Consumption and Production Patterns in Fashion. In: Gardetti, M., Muthu, S. (eds) *The UN Sustainable Development Goals for the Textile and Fashion Industry*. Textile Science and Clothing Technology. Springer, Singapore. https://doi.org/10.1007/978-981-13-8787-6_4
16. Shutaleva, A. (2023). Ecological culture and critical thinking: building of a sustainable future. *Sustainability*, 15(18), 13492. <https://doi.org/10.3390/su151813492>
17. Waghid, Z. (2024). Cultivating critical thinking, social justice awareness and empathy among pre-service teachers through online discussions on global citizenship education. *Journal of Creative Communications*, 19(1), 74-93. <https://doi.org/10.1177/09732586231194438>
18. Valli, L., & Rennert-Ariev, P. (2002). New standards and assessments? Curriculum transformation in teacher education. *Journal of Curriculum Studies*, 34(2), 201-225. <https://doi.org/10.1080/00220270110093625>
19. Priestley, M. Schools, teachers, and curriculum change: A balancing act?. *J Educ Change* 12, 1–23 (2011). <https://doi.org/10.1007/s10833-010-9140-z>

20. Kandiko Howson, C., & Kingsbury, M. (2023). Curriculum change as transformational learning. *Teaching in Higher Education*, 28(8), 1847-1866. <https://doi.org/10.1080/13562517.2021.1940923>
21. Xinming, Z. (2023). Research on cultivating innovation and practical skills in higher vocational education. *Frontiers in Educational Research*, 6(26), 29-36. <https://10.25236/FER.2023.062606>
22. Aithal, P. S. and Maiya, Adithya Kumar. (2023). Innovations in Higher Education Industry – Shaping the Future. *International Journal of Case Studies in Business, IT, and Education (IJCSBE)*, 7(4), 283-311. ISSN: 2581-6942. (2023)., Available at SSRN: <https://ssrn.com/abstract=4674658>
23. Parry, S., Metzger, E. Barriers to learning for sustainability: a teacher perspective. *Sustain Earth Reviews* 6, 2 (2023). <https://doi.org/10.1186/s42055-022-00050-3>
24. Lorente-Echeverría, S., Murillo-Pardo, B., & Canales-Lacruz, I. (2022). A systematic review of curriculum sustainability at university: a key challenge for improving the professional development of teachers of the future. *Education Sciences*, 12(11), 753. <https://doi.org/10.3390/educsci12110753>
25. Muschard, B., & Seliger, G. (2015). Realization of a learning environment to promote sustainable value creation in areas with insufficient infrastructure. *Procedia CIRP*, 32, 70-75. <https://doi.org/10.1016/j.procir.2015.04.095>
26. Penuel, W. R. (2019). Infrastructuring as a practice of design-based research for supporting and studying equitable implementation and sustainability of innovations. *Journal of the Learning Sciences*, 28(4-5), 659-677. <https://doi.org/10.1080/10508406.2018.1552151>
27. Thake, A. M. (2025). Transitioning to a green economy—the impact on the labor market and workforce skills. In *Greening our economy for a sustainable future* (pp. 163-175). Elsevier. <https://doi.org/10.1016/B978-0-443-23603-7.00013-3>
28. Castaño, C., Caballero, R., Noguera, J. C., Chen Austin, M., Bernal, B., Jaén-Ortega, A. A., & Ortega-Del-Rosario, M. D. L. A. (2025). Developing Sustainability Competencies Through Active Learning Strategies Across School and University Settings. *Sustainability*, 17(19), 8886. <https://doi.org/10.3390/su17198886>
29. Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *bmj*, 372. <https://doi.org/10.1136/bmj.n71>
30. Nguyen, L. T. V., Cleveland, D., Nguyen, C. T. M., & Joyce, C. (2024). Problem-based learning and the integration of sustainable development goals. *Journal of Work-Applied Management*, 16(2), 218-234. DOI 10.1108/JWAM-12-2023-0142
31. Holst, J., Grund, J., & Brock, A. (2024). Whole Institution Approach: measurable and highly effective in empowering learners and educators for sustainability. *Sustainability Science*, 19(4), 1359-1376. <https://doi.org/10.1007/s11625-024-01506-5>
32. Asikainen, E., & Tapani, A. (2021). Exploring the connections of education for sustainable development and entrepreneurial education—A case study of vocational teacher education in Finland. *Sustainability*, 13(21), 11887. <https://doi.org/10.3390/su13211188>
33. Chinedu, C. C., Saleem, A., & Wan Muda, W. H. N. (2023). Teaching and learning approaches: curriculum framework for sustainability literacy for technical and vocational teacher training programmes in Malaysia. *Sustainability*, 15(3), 2543. <https://doi.org/10.3390/su15032543>
34. Igberaharha, C. O. (2021). Improving the Quality of Technical Vocational Education and Training (TVET) for Sustainable Growth and Development of Nigeria. *Journal of Education and e-Learning Research*, 8(1), 109-115.
35. Budi, A. H. S., Juanda, E. A., Indrawan, D., Henny, H., & Masek, A. (2024). Integration of Sustainable Development Competency Points into the Telecommunication System Subjects at Vocational High School. *Journal of Technical Education and Training*, 16(3), 232-237. <https://doi.org/10.30880/jtet.2024.16.03.016>
36. Lehmann, T., Iyer-Raniga, U., & Mahoney, K. (2025). Learning for sustainability: Adult transformative learning through sustainability and culturalism perspectives. *Social Sciences & Humanities Open*, 11, 101523. <https://doi.org/10.1016/j.ssaho.2025.101523>
37. Georgieva, T., Grau, Y., Berova, M., Georgieva, R., & Yordanov, Y. (2021). Innovations in the professional education of teachers and trainers in the field of sustainable agriculture development. *Bulgarian Journal of Agricultural Science*, 27.
38. Furdui, A., Lupu-Dima, L., & Edelhauser, E. (2021). Implications of entrepreneurial intentions of Romanian secondary education students, over the Romanian business market development. *Processes*, 9(4), 665. <https://doi.org/10.3390/pr9040665>
39. Lambini, C. K., Goeschl, A., Wäsch, M., & Wittau, M. (2021). Achieving the sustainable development goals through company staff vocational training—The case of the federal institute for vocational education and training (bibb) inebb project. *Education Sciences*, 11(4), 179. <https://doi.org/10.3390/educsci11040179>
40. Fischer, D., & Barth, M. (2014). Key competencies for and beyond sustainable consumption: An educational contribution to the debate. Fischer, D., & Barth, M.(2014). Key Competencies for and beyond Sustainable Consumption: An Educational Contribution to the Debate. *GAIA-Ecological Perspectives for Science and Society*, 23, 193-200. <https://doi.org/10.14512/gaia.23.S1.7>
41. Balzannikov, M., Vavilova, T., & Vyshkin, E. (2015, June). Challenges in the transition to the Education for Sustainable Development paradigm in higher vocational education in Russia. In *ENVIRONMENT. TECHNOLOGY. RESOURCES. Proceedings of the International Scientific and Practical Conference* (Vol. 2, pp. 56-59). <http://dx.doi.org/10.17770/etr2015vol2.256>

42. Yang, W., Chinedu, C. C., Chen, W., Saleem, A., Ogunniran, M. O., Nacato Estrella, D. R., & Vaca Barahona, B. (2024). Building capacity for sustainability education: An analysis of vocational teachers' knowledge, readiness, and self-efficacy. *Sustainability*, 16(9), 3535. <https://doi.org/10.3390/su16093535>
43. Khademi-Vidra, A., & Bakos, I. M. (2023). The Impact of Sustainable Education Practices on Food Consumption Behaviours—An Experimental Study of Agrarian School's Students in Hungary. *European Journal of Contemporary Education*, 12(2), 462-479. <https://ejce.cherkasgu.press>
44. Wee, Y., Kang, Y., & Kim, W. (2024). Smart Farming for Sustainable Agriculture: A Case Study through Korean Public TVET. *Journal of Technical Education and Training*, 16(2), 195-208. <https://doi.org/10.30880/jtet.2024.16.02.017>
45. Holst, J., Brock, A., Singer-Brodowski, M., & De Haan, G. (2020). Monitoring progress of change: Implementation of Education for Sustainable Development (ESD) within documents of the German education system. *Sustainability*, 12(10), 4306. <https://doi.org/10.3390/su12104306>
46. Holst, J., Singer-Brodowski, M., Brock, A., & De Haan, G. (2024). Monitoring SDG 4.7: Assessing Education for Sustainable Development in policies, curricula, training of educators and student assessment (input-indicator). *Sustainable Development*, 32(4), 3908-3923. DOI: 10.1002/sd.2865.

Disclaimer/Publisher's Note: The views, opinions, and data expressed in all publications are solely those of the individual author(s) and contributor(s) and do not necessarily reflect the views of PAP and/or the editor(s). PAP and/or the editor(s) disclaim any responsibility for any injury to individuals or damage to property arising from the ideas, methods, instructions, or products mentioned in the content.