Integrating knowledge management in smart mobility: lessons from the Green SCENT EU horizon program

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Abstract: This study explores an advanced knowledge management strategy using interactive knowledge graphs to address information silos in data management. Leveraging grounded theory, we build a theoretical framework focused on enhancing green skills education in Europe, as exemplified by the Horizon 2020-funded GreenSCENT project. This project develops a competence framework aligned with the EU Green Deal's objectives, utilizing an interactive knowledge graph for mapping and managing competences. Our analysis demonstrates that the knowledge graph effectively overcomes information silos, enabling a unified and accessible knowledge base. This approach not only streamlines knowledge utilization across the Green Deal's Smart Mobility focus area but also sets a precedent for integrating complex data sets in environmental education and beyond. The findings highlight the knowledge graph's role in visualizing competences, promoting better data integration, and facilitating informed decision-making.

Keywords: Sustainability, Traffic, Pollution, Information Silos problem, Simplexity

1. Introduction

In the first phase of the European Union's climate policy transformation, the European Commission started with the adoption of Directive 96/61/EC in 1996, which focused on integrated pollution prevention and control. This legislative action laid the groundwork for subsequent directives, including the establishment of a greenhouse gas emission allowance trading scheme within the Community in 2003 (*Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (Text with EEA relevance)*, 2003). Furthermore, participation in international climate agreements, such as the Kyoto Protocol and the Paris Agreement, marked significant steps toward global environmental governance (Agreement, 2015; Protocol, 1997). The publication of the European Green Deal (GD) communication in December 2019 signified a comprehensive approach to addressing climate change, advocating for ambitious policy transformations across eight critical focus areas, including Biodiversity, Circular Economy, Clean Energy, Climate Change, From Farm to Fork, Green Buildings, Smart Mobility, and Zero Pollution (Garito et al., 2023; Tomassi et al., 2024a). The aim is to guide the EU toward a future with no emissions by 2050, recognizing the need for a comprehensive approach to environmental stewardship in this era of rapid change. Smart Mobility, as one of the critical focus areas, addresses the need for innovative and sustainable transportation solutions (Mavlutova et al., 2023). This includes the development of efficient, clean and accessible transport systems that reduce emissions and encourage a shift to more sustainable modes of travel. Implementing these mobility solutions is crucial to reducing the environmental impact of transport and improving the quality of life in both urban and rural areas. The drive for environmental sustainability and the shift towards more intelligent mobility solutions are bolstered by several educational and awareness-raising initiatives. Projects such as the GreenSCENT, funded through the Horizon 2020 program, aim to close knowledge gaps in environmental education. By developing a comprehensive framework for sustainability competencies, these initiatives seek to instill a broad understanding of sustainable practices and their application across different sectors of society, emphasizing the importance of an informed and engaged populace in achieving environmental goals (Garito et al., 2023; Tomassi et al., 2024a).

2. Literature review

The research journey began with an in-depth literature review, focusing on identifying the core competencies at the heart of the developed Competence Framework. This process started with a thorough examination of a wide range of documents cited in well-established frameworks such as GreenComp, DigComp, DigCompEdu, and EntreComp, guided by the expertise of the Joint Research Center (JRC) (Bacigalupo, 2022; Bacigalupo et al., 2016; Cabero-Almenara et al., 2022; Kluzer and Priego, 2018). To expand this investigation, a dedicated team of thirteen researchers engaged with the Scopus and ERIC databases, searching for literature relevant to the specific focus areas of the Green Deal (GD) and the various levels of the European Qualification Framework (EQF) ("The European Qualifications Framework (EQF) | Europass," n.d.). Confronted with the challenge of analyzing a significant volume of data, the team employed a sophisticated software framework designed to utilize

natural language processing (NLP) techniques (Ma and Chen, 2024). This included the application of algorithms like latent Dirichlet allocation, cosine similarity, and Okapi BM25 to assess the relevance of the collected papers (Blei et al., 2003; Tomassi et al., 2024b). Such a methodical approach enabled a more nuanced analysis, allowing for the categorization of the literature into both quantitative and qualitative matrices (Klopper, 2007). This detailed process shed light on the existing research landscape, providing a clearer understanding of the scholarly work across the various GD focus areas and EQF levels, thus offering valuable insights for further development of the Competence Framework. The quantitative analysis underscored an uneven distribution of focus across Green Deal (GD) topics within the existing literature, particularly highlighting the need for greater emphasis on "Smart Mobility." While areas such as Climate Change and Clean Energy have been thoroughly investigated, Smart Mobility, alongside Green Building and Sustainable Agriculture ("From Farm to Fork"), has not received comparable attention. This observation is crucial, as Smart Mobility is central to transforming our transportation systems into more sustainable, efficient, and accessible networks (Tomassi et al., 2024a). Moreover, the analysis indicated that the bulk of literature targets professional workers and higher education, revealing a significant void in materials tailored for younger learners in primary and secondary education. This gap in resources emphasizes the importance of enhancing Smart Mobility's presence in educational content across all levels, advocating for a more equitable spread of knowledge that encompasses all GD focus areas and educational tiers. By addressing this imbalance, we can foster a deeper understanding of Smart Mobility's role in achieving a sustainable future, encouraging early awareness and engagement among all age groups. The qualitative review identified key documents, primarily gray literature such as reports by UNESCO, OECD, and UNEP, as pivotal in shaping the discourse on sustainability and education (McMichael et al., 1996; OECD, 2011; Taguma and Barrera, 2019; "UNESCO roadmap for implementing the Global Action Programme on Education for Sustainable Development | VOCEDplus, the international tertiary education and research database," 2014). These documents highlighted a gradual evolution in the scope of environmental education, initially targeting professionals and gradually encompassing younger demographics. The review thus emphasized the importance of inclusive and sector-specific education in fostering a comprehensive understanding of sustainability challenges and solutions.

3. Methods

The construction of the GreenComp matrix began by delving into Smart Mobility, aiming to pinpoint essential competencies required to understand, advocate, and enact solutions in this dynamic field (Figure 1).

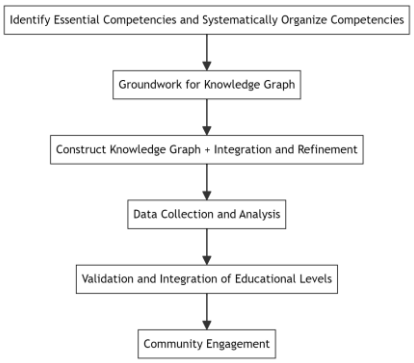

Figure 1. Flowchart explaining the methods

The matrix is designed to systematically organize these competencies, making it straightforward for users to grasp the necessary skills and knowledge for advancing Smart Mobility. Concurrently, the groundwork for the Knowledge Graph was laid out to visually represent the connections among competencies, educational materials, and practical applications in Smart Mobility. This interactive tool allows users to navigate the intricate web of skills related to Smart Mobility and their relevance to the broader objectives of the Green Deal (Tomassi et al., 2024a).

3.1 GreenComp Matrix Structure Building

The inception of the GreenComp Competence Framework was predicated on the foundational understanding derived from the literature review, facilitating the identification of competences across all GD focus areas and corresponding to various EQF levels. Distinct from existing frameworks, GreenSCENT framework boasts a nuanced and comprehensive matrix structure, encapsulating a higher-order matrix alongside several lower-order matrices, each dedicated to elucidating competences within individual GD topics. The primary matrix categorizes the specific GD topic—Smart Mobility – into distinct competence areas. These areas further encompass a variety of competences, each detailed within a specific column labeled "Competence Areas." Each competence is accompanied by a descriptor, providing a broad overview of its essence. This first-order matrix lays the groundwork for a series of second-order matrices, which elaborate on the behaviors associated with each competence. The second-order matrix classifies every competence into Knowledge, Skills, and Attitudes (KSAs), alongside columns denoting the relevant EQF education levels spanning from elementary education to professional and post-doctoral training. Each KSA is thoroughly defined in terms of the requisite knowledge, skill, or attitude, thereby fostering a deeper understanding of sustainable behaviors pertinent to the competences. Additional columns for keywords, hashtags, and notes are designed to streamline the research process during the Knowledge Graph's development, offering bibliographic references and facilitating the matrix's navigability. In the quest for sustainable urban environments, the pivotal role of smart mobility is underscored by its integration within our cities' infrastructures. Leveraging Big Data and

advanced analytics, adaptive urban mobility plans are meticulously crafted to ensure that transportation systems are not only responsive to current urban demands but are also preemptively tuned for future changes. This approach is vividly demonstrated in the deployment of Mobility as a Service (MaaS) models, which amalgamate various transportation services into a unified, user-friendly platform. Such models are emblematic of the competences required to enhance user experience and reduce environmental impacts, reflecting a direct application of the 'Systems Thinking' and 'Critical Thinking' competences outlined in our framework. Additionally, efficient city logistics optimized through smart technologies directly relate to 'Sustainable Models Identification' and 'Monitoring', enabling dynamic management of city traffic and services to minimize congestion and improve urban flow (Semanjski, 2023). The orchestration of microservices within the smart mobility framework ensures seamless operational synchrony, embodying the 'Multidisciplinary Approach' competence by integrating technical, environmental, and user-centric perspectives. These collective efforts not only foster a sustainable interaction with urban spaces but also elevate the quality of urban life, making cities smarter and more livable. Each stride forward in smart mobility not only exemplifies the practical application of our defined competences but also propels us toward the realization of more efficient, clean, and accessible urban environments (Semanjski, 2023).

3.2 Knowledge Graph Building

Recognizing the human propensity for visual information processing, the decision to transform the intricate matrix structure of the GreenComp into a Knowledge Graph was informed by the need for a more accessible and engaging educational tool. The Knowledge Graph represents a strategic adaptation to efficiently manage and communicate complex information, mitigating the challenge of information silos and enhancing user engagement through visual representation (De Nicola et al., 2022; Falegnami et al., 2022; Garito et al., 2023; Min et al., 2022; Tomassi et al., 2024a). The construction of the Knowledge Graph was guided by the principles of Grounded Theory, which offers a robust framework for the qualitative management, organization, and analysis of data. The steps involved in this process are detailed below(Allan, 2003; Bryant and Charmaz, 2007; Glaser, 1999): ***Text Coding***. This initial phase involves identifying and marking key concepts within the textual data. The coding process, comprising selective, axial, and open coding, allows for the categorization and thematic analysis of the data; ***Memorizing***: Transition notes are written concerning each identified concept, facilitating the integration and refinement of the theoretical framework underpinning the Knowledge Graph; ***Integration and Refinement***: The coded concepts are interconnected within a model centered around a core issue, employing Obsidian software to visually map these relationships. This software has proven effective in similar research endeavors, enabling complex text formatting and the hierarchical organization of concepts and links.

The coding processes, integral to Grounded Theory, are elaborated as follows: ***Selective Coding***: Identifies broad, predominant categories, with the GD focus areas serving as high-level concepts; ***Axial Coding***: Reassembles data by linking categories and concepts, performed through the identification of competences; ***Open Coding***: Establishes a flexible category system, fragmenting data to derive properties and generate a taxonomy of concepts.

This methodological approach, supported by Obsidian, facilitates the creation of a dynamic and interactive Knowledge Graph. This graph not only visualizes the connections between GD focus areas and competences but also incorporates hashtags to denote sub-topics and thematic areas, enriching the framework's comprehensive-ness and accessibility. Incorporating Grounded Theory into the creation of the Knowledge Graph marks a pivotal methodological enhancement, particularly for the nuanced examination of competencies within Smart Mobility. This approach combines visual data representation with qualitative analysis to forge an innovative educational instrument. Designed to deepen the comprehension and practical application of sustainability principles across varied sectors of society, this tool is instrumental in furthering the broad objectives of the European GD.

3.3 Data Collection and Preliminary Analysis

Data collection for enriching the Knowledge Graph extended beyond academic literature, incorporating a wide array of sources such as policy documents, industry reports, and educational materials. This diverse compilation aimed to encapsulate a holistic view of the competences relevant to the European Green Deal's objectives. Utilizing natural language processing (NLP) tools, the team systematically extracted and classified data points related to competences, skills, attitudes, and knowledge from the selected documents. This process was instrumental in identifying emergent themes and gaps within the current educational frameworks regarding sustainability and environmental education. Preliminar analysis involved a meticulous examination of the data, focusing on discerning patterns, relationships, and the distribution of competences across various sectors and educational levels. This phase was critical in ensuring that the Knowledge Graph would be representative of the multifaceted nature of sustainability education, aligning with the Green Deal's comprehensive approach.

3.4 Iterative Development and Validation of the Knowledge Graph

The development of the Knowledge Graph was inherently iterative, involving continuous refinement and expansion based on feedback from domain experts and stakeholders in the education and sustainability fields.

Each iteration involved:

Expansion: Incorporating additional data and adjusting the graph structure to reflect new insights into sustainability competences.

Refinement: Enhancing the clarity and accuracy of the connections and categories within the graph based on expert feedback and new research findings.

Validation: Engaging with stakeholders through workshops and presentations to validate the relevance and applicability of the competences outlined in the graph.

This iterative process ensured that the Knowledge Graph remained current, relevant, and responsive to the evolving landscape of sustainability education and policy (Garito et al., 2023; Tomassi et al., 2024a).

Figure 2 highlights with purplish lines the links between the Smart Mobility concepts represented as dots. The larger the dot the more connected the corresponding concept.

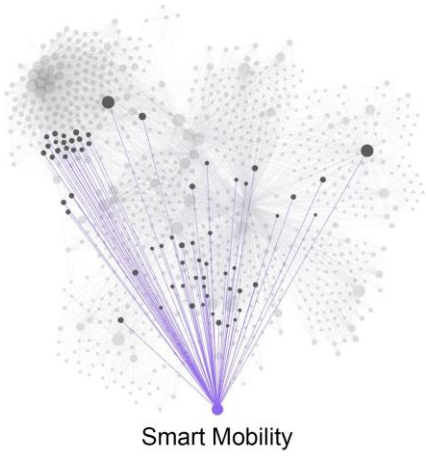

Figure 2: The Smart Mobility Knowledge Graph highlighting key connections and focal points within the network through vibrant purple lines

3.5 Integration of Educational Levels and Sector-Specific Needs

A pivotal aspect of the methodology was the integration of educational levels and sector-specific needs into the Knowledge Graph. This approach was guided by the European Qualifications Framework (EQF), ensuring that the competences were appropriately aligned with educational levels from primary education to professional development. Additionally, sector-specific competences were identified and incorporated, recognizing the varied requirements across different industries and professions in achieving sustainability goals. This layered approach facilitated the creation of tailored educational pathways and resources, enabling individuals and organizations to identify and develop the competences necessary for contributing to the Green Deal's objectives effectively.

3.6 Technological Framework and Accessibility

The technological framework underpinning the Knowledge Graph was designed with accessibility and user engagement in mind. Utilizing cutting-edge web technologies, the team developed an interactive platform that allows users to explore the competences, their interconnections, and related resources dynamically. Features such as search functionality, filtering by educational level or sector, and personalized learning pathways were integrated to enhance the user experience and foster an engaging learning environment. The platform's design also considered inclusivity, ensuring that it was accessible to users with diverse needs, including those with disabilities. This commitment to accessibility underscores the project's overarching goal of democratizing sustainability education, making it accessible and relevant to all segments of society.

3.7 Collaboration and Community Engagement

Recognizing the importance of community engagement and collaboration, the methodology included a comprehensive strategy for involving stakeholders in the development and dissemination of the Knowledge Graph. This strategy involved partnerships with educational institutions, industry associations, and non-governmental organizations (NGOs) to ensure the framework's applicability and effectiveness in fostering sustainability competences. Through workshops, seminars, and collaborative projects, the team engaged with a wide range of stakeholders to gather insights, share knowledge, and promote the integration of sustainability competences into educational curricula and professional development programs. This collaborative approach not only enriched the Knowledge Graph but also fostered a sense of ownership and commitment among stakeholders, enhancing its impact and reach. The methodology used in shaping the Competence Framework with a central focus on Smart Mobility, leading to the establishment of the Knowledge Graph, epitomizes a thorough and forward-thinking strategy for sustainability education. This approach integrates meticulous data analysis, active involvement of stakeholders, and cutting-edge technological applications. As a result, the project team has developed a vibrant and user-friendly resource that bolsters the ambitious objectives of the European Green Deal.

The Knowledge Graph, as a cornerstone of this methodology, visually maps out the essential competencies required for professionals and enthusiasts in the Smart Mobility sector. This interactive tool not only aids in the understanding and application of these competencies but also facilitates the exploration of their interconnections and impacts on broader sustainability goals. This framework serves as a valuable resource for educators, policymakers, industry professionals, and

individuals seeking to develop the competences necessary for a sustainable future. It underscores the importance of collaborative, interdisciplinary efforts in addressing the complex challenges of sustainability, offering a roadmap for integrating sustainability competences into education and professional development across Europe and beyond.

4. Key findings

The final competency describes a set of key competencies for European citizens to navigate and contribute to smart mobility. These competences are grouped in three main areas: Integrating sustainability: This area includes the promotion of nature, health, safety, security, equity and efficiency. For example, mobility should respect the landscape, vegetation and animals, and gradually shift to renewable sources of energy production and consumption; Awareness: This area includes multidisciplinary approach, systemic thinking, critical thinking, identification of sustainable models, monitoring and learning. For example, mobility problems should be approached from a global perspective, including different points of view, emerging impacts and community phenomena; Initiative: This includes individual initiative, collective initiative, political initiative, risk anticipation, opportunity exploitation and communication. For example, one should identify personal potential for smart mobility in the broadest sense and proactively change inappropriate personal habits in favour of sustainable ones.

Indeed, the exploration of the Competence Framework for the European Green Deal, particularly emphasizing Smart Mobility, has brought to light essential findings crucial for the enhancement of sustainability education and practice. These insights are categorized into various key areas, illustrating the intricate relationship among educational content, competency development, and the wider goals of environmental sustainability and policy coherence.

Central Role of Smart Mobility: The findings underscore Smart Mobility as a pivotal area within the framework, highlighting its importance in achieving the European Green Deal's ambitious sustainability targets. Smart Mobility is identified as a critical lever for reducing emissions, enhancing urban liveability, and facilitating the transition to a more sustainable and efficient transportation ecosystem. *Competency Development*: The research emphasizes the necessity for a comprehensive set of competencies in Smart Mobility, including technical knowledge, critical thinking, and innovation skills. These competencies are vital for professionals and citizens alike to navigate and contribute to the evolving landscape of sustainable transportation. *Integration with Policy Goals*: A significant insight from the research is the need for educational initiatives and competency development in Smart Mobility to be closely aligned with European and global environmental policy objectives. This alignment ensures that education and practice are geared towards tangible outcomes in sustainability efforts. *Educational Content Adaptation*: The investigation highlights the dynamic nature of Smart Mobility, calling for continuous adaptation of educational content to reflect technological advancements, policy changes, and societal shifts. This adaptability is crucial for maintaining the relevance and effectiveness of sustainability education. *Interdisciplinary Approach*: The findings advocate for an interdisciplinary approach to Smart Mobility education, integrating perspectives from environmental science, engineering, urban planning, and social sciences. Such a holistic approach is essential for addressing the multifaceted challenges of sustainable transportation. *Stakeholder Engagement*: The research points to the importance of engaging a wide range of stakeholders in the development and implementation of the Competence Framework. Collaboration among educators, industry professionals, policymakers, and communities is key to fostering a shared understanding and commitment to Smart Mobility solutions.

Another significant insight was the critical role of digital competences in enhancing sustainability education and practice. The intersection of digital literacy with environmental sustainability opens new avenues for innovation, enabling the development of smart solutions for energy efficiency, pollution reduction, and resource management, especially in critical areas of intervention such as Smart Mobility. The research underscored the necessity for effective engagement and communication strategies to promote awareness and understanding of Smart Mobility issues among the public. Findings suggest that innovative communication approaches, leveraging digital platforms and social media, can significantly enhance the visibility and impact of sustainability education. Technological advancements can facilitate the creation of virtual communities of practice, enabling learners and educators to share insights, challenges, and successes in implementing sustainability competences. Another essential aspect of the key findings pertains to the importance of establishing robust mechanisms for monitoring and evaluating the effectiveness of sustainability education programs. Continuous assessment allows for the identification of areas for improvement, ensuring that educational strategies remain aligned with the dynamic nature of sustainability challenges. Furthermore, feedback loops between policy, practice, and research are critical for refining the Competence Framework and for adapting it to future environmental, technological, and societal shifts.

While identifying core competences and the need for integrated educational strategies constitutes a major stride forward, the research also highlighted several challenges and barriers to the effective implementation of the Competence Framework. These include institutional inertia, lack of resources, and the need for professional development for educators to effectively integrate sustainability concepts into their teaching. Overcoming these barriers requires concerted efforts from policymakers, educational institutions, and stakeholders to allocate resources, provide training, and adopt flexible curricula that can adapt to the evolving demands of

sustainability education. A pivotal finding relates to the innovations in pedagogy and curriculum design that are essential for cultivating sustainability competences. Experiential learning, project-based learning, and interdisciplinary approaches were identified as particularly effective in engaging students with real-world sustainability challenges. Such pedagogical strategies not only enhance learning outcomes but also inspire creativity and critical thinking, empowering students to devise innovative solutions to environmental problems.

5. Conclusions

The technological advancements in recent years have profoundly reshaped various aspects of human life. From communication to transportation, from healthcare to entertainment, virtually every sphere of existence has been touched by innovation. The proliferation of smartphones and the widespread availability of high-speed internet have revolutionized how people connect and communicate, transcending geographical barriers and fostering global interconnectedness. Similarly, transportation has been transformed with the advent of ride-sharing services and advancements in electric and autonomous vehicles, offering convenience while addressing environmental concerns. The healthcare sector has witnessed remarkable progress with the integration of artificial intelligence and big data analytics, facilitating more accurate diagnoses and personalized treatment plans. Furthermore, the entertainment industry has experienced a paradigm shift with the rise of streaming platforms and virtual reality, providing immersive experiences tailored to individual preferences. Amidst these transformative changes, challenges such as digital privacy and cybersecurity have emerged, necessitating ongoing efforts to safeguard personal information and secure digital infrastructure. Overall, while technology has undoubtedly enhanced efficiency and convenience, it is imperative to navigate its implications thoughtfully to ensure equitable access and mitigate potential drawbacks. The research undertaken to develop a Competence Framework for education to sustainability issues as Smart Mobility, aligned with the European Green Deal, culminates in a set of pivotal insights and recommendations. These findings underscore the critical role of comprehensive sustainability education in achieving the ambitious objectives set forth by the Green Deal.

The first is the indispensable role of education in fostering a deep-seated cultural and behavioural shift towards sustainability. It becomes evident that for the European Green Deal to succeed, a concerted effort must be made to integrate sustainability competences across all levels of education and professional training. This entails a revaluation and redesign of existing curricula to include sustainability principles, promoting an understanding of the interconnectedness of social, economic, and environmental systems. In addition, the dynamic nature of sustainability challenges necessitates educational frameworks that are both adaptive and flexible. As the findings suggest, the development of competences should not be seen as a static goal but as an evolving process that adapts to new scientific discoveries, technological advancements, and societal changes. Therefore, continuous review and updating of the Competence Framework are essential to ensure its relevance and effectiveness in preparing individuals to contribute to the goals of the Green Deal. The research highlights the importance of interdisciplinary and collaborative approaches in addressing the complex challenges of sustainability such as Smart Mobility. Education systems must encourage collaboration across disciplines and sectors, fostering an environment where diverse perspectives and expertise converge to innovate solutions for sustainable development. This approach will not only enrich the learning experience but also prepare students to work effectively in diverse teams and settings.

Achieving the objectives of the Green Deal requires the active engagement and participation of all societal stakeholders, including policymakers, educators, industry leaders, and the community at large. The research underscores the need for creating platforms for dialogue and collaboration, where stakeholders can contribute to the development and implementation of sustainability education initiatives. Public awareness campaigns and community involvement projects can further augment understanding and support for sustainability goals. Leveraging technology and digital innovations emerges as a crucial strategy in enhancing sustainability education. Digital tools can provide interactive and immersive learning experiences, making sustainability education more accessible and engaging. Furthermore, technology can facilitate the sharing of resources and best practices, enabling a broader reach and impact of educational programs.

The Competence Framework for Smart Mobility presents a foundational step towards embedding sustainability at the core of educational systems. By cultivating the necessary knowledge, skills, and attitudes, individuals can significantly contribute to the realization of the European Green Deal's vision for a sustainable and resilient future. However, the success of this endeavour hinges on the collective efforts of all stakeholders, requiring a unified and proactive approach to sustainability education. As the challenges of environmental degradation and climate change continue to evolve, so too must our strategies for education and engagement. The journey towards sustainability is ongoing, and education remains our most potent tool in navigating this path, ensuring a sustainable legacy for future generations.

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101036480. The Green SCENT knowledge graph is explorable at:

https://publish.obsidian.md/greenscent/_START+HERE_

References

Agreement, P., 2015. Paris agreement. Presented at the Report of the Conference of the Parties to the United Nations Framework Convention on Climate Change (21st Session, 2015: Paris). Retrived December, HeinOnline, p. 2017.

Allan, G., 2003. A critique of using grounded theory as a research method. Electronic journal of business research methods 2, pp1-10.

Bacigalupo, M., 2022. GreenComp The European sustainability competence framework.

Bacigalupo, M., Kampylis, P., Punie, Y., Van den Brande, G., 2016. EntreComp: The entrepreneurship competence framework. Luxembourg: Publication Office of the European Union 10, 593884.

Blei, D.M., Ng, A.Y., Jordan, M.I., 2003. Latent Dirichlet Allocation. Journal of Machine Learning Research 3, 993–1022.

Bryant, A., Charmaz, K., 2007. Grounded theory in historical perspective: An epistemological account. The SAGE handbook of grounded theory 31–57.

Cabero-Almenara, J., Gutiérrez-Castillo, J.J., Palacios-Rodríguez, A., Barroso-Osuna, J., 2022. Comparative European DigCompEdu Framework (JRC) and Common Framework for Teaching Digital Competence (INTEF) through expert judgment. Texto Livre 14.

De Nicola, A., Villani, M.L., Costantino, F., Di Gravio, G., Falegnami, A., Patriarca, R., 2022. A Knowledge Graph to Digitalise Functional Resonance Analyses in the Safety Area, in: Resilience in a Digital Age. Springer, pp. 259–269.

Falegnami, A., Bernabei, M., Colabianchi, S., Tronci, M., 2022. Yet Another Warehouse KPI's Collection. Presented at the XXVII Summer School "Francesco Turco" – «Unconventional Plants», Sanremo, Riviera dei Fiori.

Garito, M.A., Caforio, A., Falegnami, A., Tomassi, A., Romano, E., 2023. Shape the EU future citizen. Environmental education on the European Green Deal. Energy Reports, Technologies and Materials for Renewable Energy, Environment and Sustainability 9, 340–354. https://doi.org/10.1016/j.egyr.2023.06.001

Glaser, B.G., 1999. The future of grounded theory. Qualitative Health Research 9, 836–845. https://doi.org/10.1177/104973299129122199

Klopper, R., * Lubbe, Sam** & Rugbeer Hemduth***, 2007. The matrix method of literature review. Alternation 14, 262–276. https://doi.org/10.10520/AJA10231757_377

Kluzer, S., Priego, L.P., 2018. DigComp into action: Get inspired, make it happen. A user guide to the European Digital Competence Framework (No. JRC110624), JRC Research Reports, JRC Research Reports. Joint Research Centre (Seville site).

Ma, Z., Chen, Z.S., 2024. Mining construction accident reports via unsupervised NLP and Accimap for systemic risk analysis. Automation in Construction.

Mavlutova, I., Atstaja, D., Grasis, J., Kuzmina, J., Uvarova, I., ..., 2023. Urban Transportation Concept and Sustainable Urban Mobility in Smart Cities: A Review. Energies.

McMichael, A.J., Haines, J.A., Slooff, R., Sari Kovats, R., Health, W.H.O.O. of G. and I.E., Change, W.T.G. on H.I.A. of C., 1996. Climate change and human health : an assessment (No. WHO/EHG/96.7). World Health Organization.

Min, W., Liu, C., Xu, L., Jiang, S., 2022. Applications of knowledge graphs for food science and industry. PATTER 3. https://doi.org/10.1016/j.patter.2022.100484

OECD, 2011. The OECD approach. OECD, Paris. https://doi.org/10.1787/9789264111356-4-en

Protocol, K., 1997. Kyoto protocol", UNFCCC Website.

Semanjski, I.C., 2023. Smart Urban Mobility: Transport Planning in the Age of Big Data and Digital Twins. Elsevier.

Taguma, M., Barrera, M., 2019. Future of Education and Skills 2030: Curriculum Analysis. OECD.

The European Qualifications Framework (EQF) | Europass [WWW Document], n.d. URL https://europa.eu/europass/en/european-qualifications-framework-eqf (accessed 11.10.22).

Tomassi, A., Caforio, A., Romano, E., Lamponi, E., Pollini, A., 2024a. The development of a Competence Framework for Environmental Education complying with the European Qualifications Framework and the European Green Deal. The Journal of Environmental Education 55, 153–179. https://doi.org/10.1080/00958964.2023.2259846

Tomassi, A., Falegnami, A., Romano, E., 2024b. Mapping automatic social media information disorder. The role of bots and AI in spreading misleading information in society. PLOS ONE 19, e0303183. https://doi.org/10.1371/journal.pone.0303183

UNESCO roadmap for implementing the Global Action Programme on Education for Sustainable Development | VOCEDplus, the international tertiary education and research database [WWW Document], 2014. URL https://www.voced.edu.au/content/ngv:70467 (accessed 11.10.22).