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Integrating Sustainability into Logistics Oriented Education in Europe

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Abstract: In the last decades, logistics has become an important industry sector, with significant impacts on the environment generated through several internal and external logistic processes. We analysed and elaborated on integrating sustainability topics within logistics-oriented programmes at universities across Europe, based on a framework of systemising and classifying sustainability terms. We also analysed pedagogical approaches within the identified courses. In our study, we perceived a moderate diversity of courses from the system and horizontal sustainability perspectives. Courses mostly focus on "principle" and "approach" levels, denoting specialised courses, with less environmental and social topics. Such coverage and distribution might imply a limitation to develop complex, multi-dimensional, and inter-disciplinary understanding, thinking, and problem-solving required for real-world challenges, comprehending all the dimensions. We also perceived a scarcity by using pedagogical approaches, where the majority of the courses emphasise traditional ones. This paper's novelty lies in providing the first empirical evaluation and elaboration of logistics-oriented programmes at European universities from a sustainability perspective. Thus, our study enriches current knowledge and research on sustainability integration into curricula at the university level, enabling new insights and better correlations between various study fields and pedagogical approaches used.

Keywords: sustainability; curricula; logistics oriented programmes and courses; pedagogical approaches

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1. Introduction

It has been 33 years since the publication of the report "Our Common Future" [1], expressing concerns about the future world's development, and grounding the sustainable development concept. The report argued that sustainability objectives should be a significant concern to everyone. Governments must integrate environmental considerations, especially in economic decision-making and planning at all the policy levels [1]. The importance of sustainability fostered various measures and recommendations in the form of rules, laws, and voluntary agreements, considered and integrated into national legislation by many countries worldwide [2].

Education is the main contributor to improving the state of the world and approaches sustainability challenges [3] exposed and highlighted in many documents published by international organisations such as the United Nations. Education thus represents one of the United Nations Sustainable Development Goals [4,5]. In addition, the European Green Deal exposed the importance of education, where Europe has an intention to become

carbon-neutral by 2050 [6] Voulvoulis and Burgman [7] stressed that education is the most significant science and technology used to address global sustainability issues.

The importance of incorporating sustainability topics into education, including higher education, has been widely recognised [8,9]. Orr [10] discussed that it is crucial to teach students about sustainability to apply their knowledge to protect the environment. Haddock-Fraser et al. [11] claimed that sustainability-related skills and expertise are essential for future leaders and decision-makers and a vital element of graduates' attributes. Wright [12] elaborated on the international higher education declarations related to sustainability and identified the most appealing priorities. Calder and Clugston [13] further examined these priorities, providing suggestions on integrating sustainability into university, not taking into account only the curriculum and research and other services. Thus, university leaders extensively acknowledge the importance of sustainability [14]. Universities became engaged in integrating sustainability into their systems, especially in the curricula [15]. Engineering and technical universities have been the frontrunners of incorporating sustainability into educational programmes [9,16]. As discussed by Filho et al. [17], despite increasing awareness of sustainable development challenges, integrating sustainability into curricula is still limited. However, we cannot neglect sustainability issues in logistics education. Logistics is one of the critical economic sectors most closely anchored to economic growth, social stability, and environmental issues. According to Statista [18], the global market size is over EUR 5 trillion and is growing substantially, considering the increased urbanisation and world population. Furthermore, the sector comprises 1.2 million companies in the EU, employing 11 million people, and representing 5% of the gross domestic product [19]. The role of the logistics sector is amplified with the immense development of technologies, contributing to the development of e-commerce [20].

The European Environment Agency [21] discussed that transport plays a vital role, as economic processes depend on efficient transport and logistics systems. Nevertheless, transportation and logistics are critical sources of environmental impacts contributing to climate change, representing 24% of greenhouse gas emissions [19]. In contrast, the EU Green Deal wants to achieve 90% emission reduction by 2050 [6]. Supported by policy directives and environmental laws, logistics companies face a demand to carry out more sustainable business practises [22]. It is essential to notice that the logistics sector does not encompass only transport activities, but is also embedded in other economic activities and sectors. Thus, logistics students must be exposed to sustainability topics, enabling them to solve complex real-world logistics challenges by considering all the sustainability dimensions. Kovács and Spens [23] recommended that logisticians continuously improve their knowledge and learn about recent innovations.

We have found few studies that assessed and elaborated logistics courses or programmes. For example, Wu [24] provided a first empirical analysis of logistics courses offered worldwide, describing a logistics curriculum from different perspectives and perceiving that courses within logistics programmes vary between higher education institutions. Some institutions have separate academic departments, and some have logistics programmes integrated into existing programmes, e.g., marketing, transportation, and operational management, indicating mandatory and elective courses. Gravier and Farris [25] reviewed educational logistics papers and exposed that the studies are not emphasising curriculum requirements in the future, but instead entirely focusing on the logistics industry's present conditions. However, logistics sectoral needs might not be fully in compliance with global society's current requirements, impacted by the pandemic and global climate change. Furthermore, Hocaoğlu et al. [26] investigated logistics-oriented programmes and courses in Turkey and identified "courses groups." The largest one was transport-oriented courses (15%), followed by supportive courses (e.g., energy logistics, urban logistics, disaster logistics, project management, etc.) (13%), operational management (13%), supply chain management-oriented courses (32%), law-oriented courses (10%), introductory courses (8%), warehousing (5%), and information systems (4%). We also perceived studies acknowledging the importance of integrating and implementing sustain-

able logistics and supply chain-related activities. For example, Stindt [27] recognised the importance of sustainability and its integration into supply chain management, bringing new challenges into the decision-making process, whereas Wong et al. [28] claimed that sustainability and environment-related topics will receive greater attention in the future logistics sector. Wagner et al. [29] suggested that environmental skills do not meet the logistics industry requirements.

However, there are no published papers that examined the sustainability issues in logistics-oriented programmes. The need for investigating sustainability is further supported by an argument by Lozano et al. [30], wherein the authors discussed the demand for actual integration of sustainability into higher education institutions' curricula, focusing on the "delivery stage" and pedagogical approaches, spurring the acquisition of required sustainability competencies. Filho et al. [17] discussed that despite increasing awareness of sustainable development challenges, integrating sustainability into curricula is still limited.

Inspired by the exanimated literature review and challenges in the logistics education identified, especially those linked to global society's needs, we address the following research question:

RQ1: How well are sustainability topics embedded in sustainability-oriented courses at logistics-related programmes at Europe's best universities?

RQ2: Which pedagogical approaches or teaching methods were used when introducing sustainability topics?

This paper represents an elaboration on incorporating sustainability-oriented bachelor's and master's courses within logistics-oriented programmes at European universities, listed in the top 200 at the Academic Ranking of World Universities (ARWU), following the systematisation of sustainability terms developed by Glavič and Kovačič Lukman [31]. The objective is to acquire knowledge and understanding of the state of the art in the logistics higher education field, including the content of the sustainability courses identified and employed pedagogical approaches. Its novelty lies in the first empirical evaluation and elaboration from systemic and systematic perspectives of sustainability-oriented courses at the best European universities. We also discuss correlations and discrepancies from the sustainability curriculum perspective in already examined higher education engineering programmes, such as chemical or environmental engineering.

We arranged this paper into the following sections: Section 2 indicates an extensive literature examination about sustainability integration in the higher education sector in the last five years, sourced from Web of Science (WoS), also elaborating on the existing logistics education literature review. Section 3 represents the methodology used for the selection processes, analyses, and sustainability assessment of the courses, followed by an examination of the pedagogical approaches. Section 4 describes the results obtained, which are further discussed and correlated to the existing studies in Section 5. Section 6 elaborates on conclusions.

2. Literature Review

This section represents a comprehensive literature review of the last five years, sourced from Web of Science (WoS), which we chose because it serves the world's leading citation databases, where Journal Citation Reports (JCR) encompass high-impact journals [32]. The WoS query and relevant papers for our study that we included in the literature review are represented in Table 1.

Table 1. Web of Science (WoS) query.

Data Source	Keyword	Paper Type Filter	Hits	Relevant Papers
WoS	Sustainability and higher education Sustainability and logistics education Sustainability and logistics curricula	Article, Review	614	36

The annual distribution of relevant papers is represented in Figure 1. We perceived that the topic is interesting from a research perspective. Considering relevant papers for our study, the number of published articles had a positive increasing trend, except in 2020, where we perceived less published papers relevant to our study.

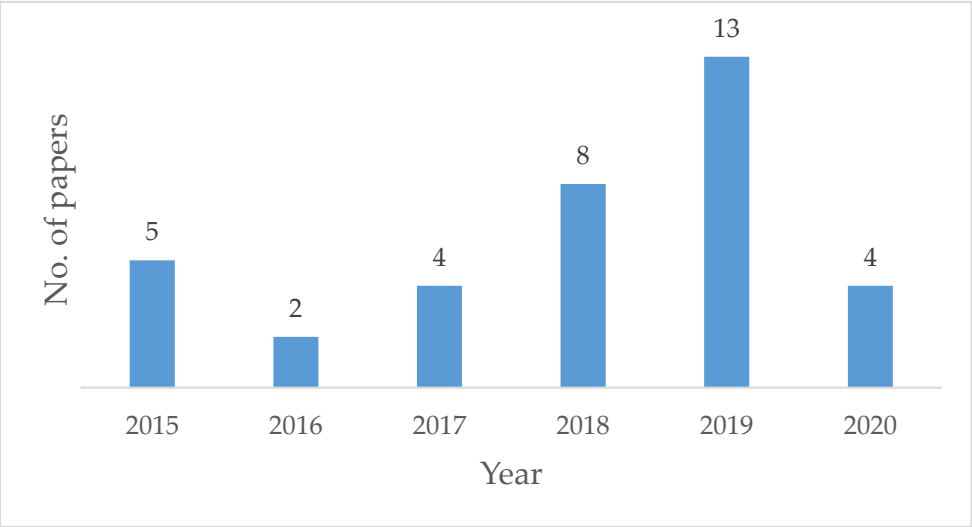


Figure 1. An annual distribution of relevant papers.

Furthermore, we identified three leading journals promoting sustainability education in different fields. These were *Sustainability*, *International Journal of Sustainability in Higher Education*, and *Journal of Cleaner Production*, in which over 75% of papers relevant to our study were published, see Table 2.

Table 2. Number of papers per journal.

Journal	No. of Papers
Sustainability	10
International Journal of Sustainability in Higher Education	9
Journal of Cleaner Production	8
Sustainable Development	1
Journal of Sustainable Tourism	1
Sustainability Science	1
Studies in Higher Education	1
International Journal of Sustainable Development & World Ecology	1
International Journal of Physical Distribution & Logistics Management	1
Thinking Skills and Creativity	1
The International Journal of Life Cycle Assessment	1
Canadian Journal of Higher Education	1

It is crucial to notice that this literature review does not examine the sustainability of the whole university's system, e.g., management, operations, research, and outreach, but rather emphasises recent research on sustainability integration into higher education curricula. Based on the papers reviewed, we structured this section into four sub-sections: evaluating the integration of sustainability into curricula, methods for assessing the level of integration, practises and guidelines about sustainability integration for acquiring

desired sustainability competencies and knowledge, and pedagogical approaches for teaching sustainability.

2.1. Evaluating Curricula from a Sustainability Perspective

The studies reviewed surveyed and assessed the integration of sustainability into higher education curricula within specific study programmes, universities, or considering a broader scope at national, regional, or global levels.

Researchers extensively surveyed architecture-oriented programmes. For instance, Porras Álvarez et al. [33] examined architecture-oriented programmes for sustainability courses in 11 Asian countries. The results showed that the fraction of sustainability courses differed from less than 5% to 25%. Rieh et al. [34] also studied architecture programmes from a sustainability perspective at Korean universities. The results indicated significant environmental orientation. However, the study suggested a lack of comprehensiveness in sustainability education, as it should also have included the social and economic perspective. These results are in line with Lozano and Barreiro-Gen's [35] recent study, which argued that even courses at European universities at least address social issues. Maruna [36] evaluated the urbanism-oriented MSc program at the University of Belgrade to observe the state of sustainability content within the curricula. The findings revealed moderate sustainability integration and suggested improvement options. Bina et al. [37] assessed a sustainability integration at 25 of the best master's programmes in Europe, China, the USA, and countries in the southern part of the globe, perceiving progress especially at the top institutions.

Furthermore, Cotterell et al. [38] studied international undergraduate tourism courses and perceived that courses do not include many sustainability topics. Researchers also studied the integration of sustainability at business-oriented programmes and universities. Hart et al. [39] studied the top 100 US MBA programs and claimed that the best schools are more likely having academic sustainability programs.

Curriculum studies also examined technology- and science-oriented programmes. For example, Malik et al. [40] discussed that existing technology curricula have a scarcity in sustainability topics that help students understand the concept's complexity.

O'Byrne et al. [41] assessed the curricula of English-language programmes in sustainability science, where outcomes suggest their divergence, and many do not integrate sustainability to a sufficient level.

Several authors examined whole universities, also at the country level. For example, Wyness and Sterling [42] studied the status of sustainability integration at Plymouth University and found that sustainability-related education mostly exists as an "add-on" in specialised programmes. Sánchez-Carracedo et al. [43] researched sustainability-oriented courses and identified 16 non-unified programmes in Spain. Additionally, Andrades Peña et al. [44] assessed the sustainability curricula at Spanish public universities, arguing there is a lack of sustainability-oriented courses despite many universities' commitments to sustainability. Larrán-Jorge et al. [45] also evaluated Spanish universities and perceived deliberate progress. Poon [46] drew the same conclusion when elaborating on the sustainability courses in Australia. The author observed a moderate implementation, showing a divergence from the policy directives and their application. Inversely, Sima et al. [47] studied curricula in Romania and found a substantial integration of sustainability-oriented topics, especially in the natural sciences and technical and engineering programmes. Sánchez-Carracedo et al. [48] also studied technology and engineering programmes, and the results suggested less sustainability homogeneously in technology and engineering degrees. Furthermore, Waqar Ashraf and Alanezi [49] represented sustainability education at engineering programs in Saudi universities and summarised that the current state is not promising.

Furthermore, Friman et al. [50] evaluated bachelor's degrees in Brazil and Finland. The authors argued that divergent curricula exist and that a balance should be found to guarantee the required sustainability competencies for all the students. In addition,

Filho et al. [17] studied higher education institutions across seven countries on various continents. The study showed a lack of sustainability integration, supporting the scarcity of sustainability issues in existing curricula.

A literature review shows progress compared to the previous decade when observing the activities of integrating sustainability into the curricula. Nevertheless, in general, the authors report insufficient coverage of sustainability topics within the higher education curricula, and a significant discrepancy at universities between the topics and programmes covered. Furthermore, the integration level even depends on the ranking lists, where top universities are at the forefront.

2.2. Curriculum Evaluation Methods

Following a desire to comprehensively and objectively assess sustainability integration into curricula, researchers developed various methods. For example, Trad [51] developed a tool based on sustainability competencies and measured sustainability curriculum integration at the University of Technology, Sydney. The results highlighted a lack of sustainability within the curricula as sustainability courses represented only 7.7% of the engineering curricula. Many sustainability assessment tools were developed, embedding curriculum issues in the form of one or more indicators, in details elaborated by Findler et al. [52], where the authors exposed impacts on sustainability as consequences of the universities' activities.

Development and employment of different methods and tools for curriculum assessment from a sustainability perspective should be encouraged. Various methods and tools are usually limited by the number of indicators or the scope they are encompassing. However, this diversity of approaches and consequently a different viewpoint about sustainability issues in curricula permits comprehensive and holistic evaluations, which is the scope of this paper, using a framework developed by Glavič and Kovačič Lukman [31].

2.3. Practises and Guidelines for Sustainability Integration into Curricula

A deficiency in comprehensive sustainability education, addressed and recognised by the authors in Section 2.1, led to the research and publications on practises and guidelines on how sustainability should be integrated and taught.

Chen et al. [53] researched sustainable industry needs for future managers by carrying out a brainstorming process with industrial professionals. The industry experts identified 52 sustainability topics, which they pronounced as crucial, and a need to consider these topics by curriculum designer, assuring that students acquire the necessary sustainability competencies.

Schulze et al. [54] carried out a literature review to discover existing studies on specific sustainability competencies required for implementing sustainable purchasing and supply management and proposed a framework of sustainable purchasing and supply chain competencies. Furthermore, Rodriguez-Andara et al. [55] delivered a roadmap for developing sustainability skills in engineering curricula by integrating sustainability-related courses.

In our literature review, we also perceived empirical examples regarding the integration of sustainability, e.g., Olweny [56] represented a case of incorporating sustainability into an undergraduate programme at the School of Architecture, Uganda, followed by a sustainability integration at the University of Hong Kong within the design curricula [57]. Additionally, Anand et al. [58] represented case studies from Canadian universities, focusing on implementing sustainability-oriented curricula in higher education institutions in Quebec. The authors found out that "a community of practice" approach improved students' understanding of the principles of sustainable development. Cincera et al. [59] represented enhancements of a sustainability-driven entrepreneurship curriculum developed within the European project. We also perceived a more specific integration of sustainability topics into engineering curricula, e.g., Cosme et al. [60] represented a case of a life cycle assessment course based on the learning-by-doing methodological approach.

There was also a study about the importance of integrating sustainability topics within the core curricula, discussed by Hess and Maki [61]. The authors highlighted the challenge of university students in the United States not believing in climate change, as they did not encounter environmental or sustainability topics during their studies. Another good example was perceived by Fuertes-Camacho et al. [62], who represented a sustainability curriculum integration at the Catalan International University to develop and enhance sustainable competencies by third-year students in nursing studies. Fuertes-Camacho et al. [62] discussed many positive impacts of such sustainability education, which will be extensive and persistent because the students' future work is related to children.

The reviewed studies encompassed different concepts and examples of sustainability integration, such as creating specific sustainability courses, conceptualisations of horizontal sustainability curriculum integration, and employment of experimental didactical methods to increase knowledge, skills, and competencies. A variety of examples offers educators and curriculum designers support and motivation to adopt and modify good practises according to their needs.

2.4. Pedagogical Approaches for Teaching Sustainability-Oriented Courses

As discussed by Seatter and Ceulemans [63], sustainability education at the higher education level should educate students in understanding the complexity of sustainable development. Despite the complexity, sustainability education should teach students how to analyse and synthesise sustainability issues, introducing causality of effect and building capacities for appropriate solutions from environmental, economic, social, and decision-making perspectives. Lozano et al. [30] carried out a comprehensive literature review on pedagogical approaches at universities, proposing a framework of 12 pedagogical approaches for teaching sustainability, developing a framework that supports educators in creating and designing sustainability courses. Tejedor et al. [64] researched Spanish universities and proposed five learning strategies (service learning, problem-based learning, project-oriented learning, simulation games, and case studies) for sustainability learning. Finnveden et al. [65] investigated lecturers' competencies at Swedish universities. They stated that lecturers have a shortage of didactic and pedagogic competencies, representing a significant issue for integrating sustainability into the courses [65]. Hensley [66] provided a theoretical discussion for incorporating mindfulness into higher education institutions (HEIs), claiming that mindfulness and creativity enable students to tackle complex sustainability challenges, requiring transformed pedagogy and curricula. Furthermore, Christie et al. [67] explored pedagogical approaches at Australian universities. They found out that academics favour and apply mostly lectures, tutorials, critical thinking, and discussions to their teaching, whereas adopting innovative approaches is low.

Thus, various pedagogical approaches exist where lecturers or professors are very independent, especially at the university level, regarding their employment. However, suitable and effective pedagogical methods have many positive and long-term impacts on educational outcomes and society. As extensively discussed by Seatter and Ceulemans [63], a transformative learning approach should be a baseline for effective and efficient sustainability education.

3. A Methodology of Selection and Evaluation of Sustainability Issues within Logistics-Oriented Courses and Their Contents

In the following section, we represent our methodology for selecting and evaluating sustainability-oriented courses and topics within them. The methodology consists of several stages, e.g., universities' selection procedures, identification of logistics-oriented programmes, analysis of course titles and syllabuses, classification and systemisation, and classification of existing pedagogical approaches within the identified courses. We explain the overall methodology in Figure 2. We carried out the initial research at the beginning of 2019, primarily considering academic year 2018/2019. In April and May 2020, we examined additional courses syllabuses, descriptions, and pedagogical approaches; thus, we updated the initial review from the academic year 2018/2019 with the academic year 2019/2020.

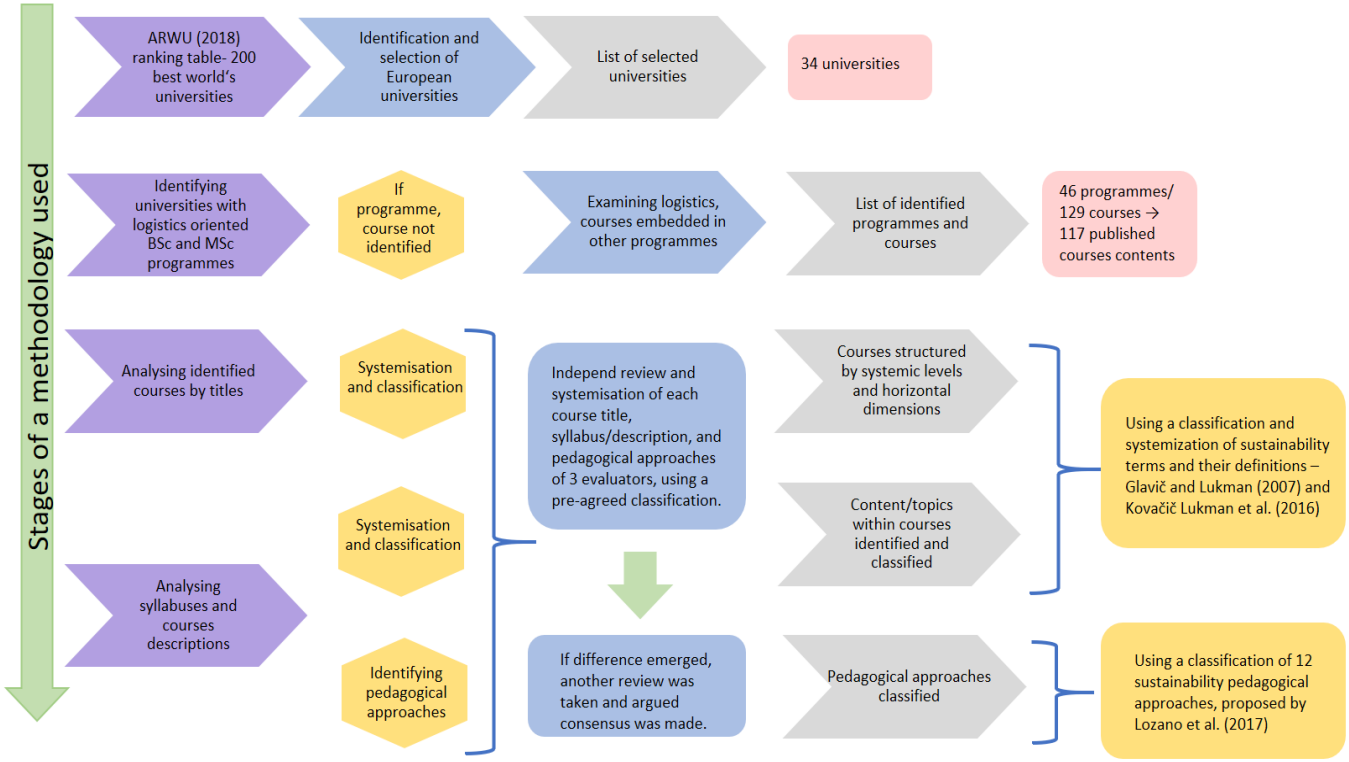


Figure 2. The overall methodology used.

3.1. Identification and Selection of European Universities

The first activity was to select bachelor's (BSc) and master's (MSc) logistics-oriented programmes for analysis and further elaboration. For university selection, and consequently selection of the programmes and courses, we used the Top 200 Universities 2018 ranking list [68], which lists universities considering six objective indicators:

- No. of alumni and staff winning Nobel Prizes and Field Medals;
- No. of highly cited researchers selected by Clarivate Analytics;
- No. of articles published in journals about nature and science;
- No. of articles indexed in the Science Citation Index (SCI), SCI—Expanded, and the Social Science Citation Index; and
- per capita performance of the university.

It is important to highlight that only 14 European countries have universities listed within Top 200 Universities, which are Switzerland and Norway. However, we found logistics bachelor's and master's programmes in 11 European countries with universities within the world's 200 best (see Table 3).

Table 3. Selected universities among Top 200, according to the Academic Ranking of World Universities (ARWU) 2018.

Country	Top 200 European Universities
Belgium (B.E.)	Ghent University, KU Leuven, Catholic University of Louvain, Université libre de Bruxelles (ULB)
Denmark (D.K.)	University of Copenhagen, Aarhus University, Technical University of Denmark
Finland (F.I.)	University of Helsinki

Table 3. *Cont.*

Country	Top 200 European Universities
France (F.R.)	Sorbonne University, University of Paris-Sud (Paris 11), Ecole Normale Superieure—Paris, Aix Marseille University, University of Strasbourg, University Paris Diderot—Paris 7, Université Grenoble Alpes, University of Paris Descartes (Paris 5)
Germany (D.E.)	Heidelberg University, Technical University Munich, University of Munich, University of Goettingen, University of Bonn, University of Frankfurt, University of Freiburg, TU Dresden, University of Cologne, University of Hamburg, University of Leipzig, University of Muenster, University of Tuebingen, University of Wuerzburg
Ireland (I.E.)	Trinity College Dublin
Italy (I.T.)	University of Milan
Netherlands (N.L.)	Utrecht University, University of Groningen, Leiden University, Erasmus University Rotterdam, Radboud University Nijmegen, University of Amsterdam, University of Wageningen, VU University Amsterdam, Delft University of Technology
Norway (N.O.)	University of Oslo, Norwegian University of Science and Technology—NTNU
Portugal (P.T.)	University of Lisbon
Spain (E.S.)	University of Barcelona
Sweden (S.E.)	Karolinska Institute, Uppsala University, Stockholm University, Lund University, University of Gothenburg
Switzerland (C.H.)	Swiss Federal Institute of Technology Zurich, University of Zurich, University of Geneva, Swiss Federal Institute of Technology Lausanne, University of Basel, University of Bern, University of Lausanne
United Kingdom (U.K.)	University of Cambridge, University of Oxford, University College London, Imperial College London, The University of Edinburgh, The University of Manchester, King's College London, University of Bristol, Cardiff University, The University of Sheffield, University of Birmingham, University of Leeds, University of Liverpool, University of Nottingham, University of Southampton, University of Warwick, London School of Economics and Political Science, London School of Hygiene & Tropical Medicine, Queen Mary University of London, The University of Glasgow, University of Exeter

3.2. Identifying and Analysing Programmes and Courses

Following the identification of universities, we identified their BSc and MSc logistics-oriented study programmes. If we perceived no BSc or MSc logistics programme at the universities, we identified logistics-related programmes, such as transportation and traffic (which are usually embedded within civil engineering) or supply chain management (as a part of Business departments); see Appendix A. Our study identified 46 logistics programmes with sustainability courses, where the majority were MSc (78.3%), followed by BSc (21.7%) programmes. We identified 129 sustainability-oriented courses in these programmes, where 91% made their contents visible via syllabuses and course descriptions. Thus, 117 courses were investigated in depth.

The course titles and their sustainability orientation represented our first stage of review and classification. Consequently, it might be inaccurate and imprecise to examine the courses based on titles only. Sometimes courses might emphasise a sustainability-oriented title, yet from the content perspective they do not cover such topics. Thus, we carried out a second stage of the evaluation, considering a more in-depth investigation of courses identified and their contents by examining course syllabuses. If not available, we examined course descriptions to identify sustainability content and specific topics covered,

which we also systemised. In our study, we perceived 75% of syllabuses available, and 25% course descriptions available.

The framework we used for our research is based on a classification of the terms, employing their definitions (see Figure 3). The essence is a systems approach, where elements (terms and their definitions) are interlinked. In this way, we considered the sustainability terms as a hierarchical, interlined structure of principles, approaches, sub-systems, and sustainable systems. In detail, principles have the narrowest meaning semantically and refer to one activity only. Thus, we placed them at the lowest level. However, principles introduce an essential element for designing more complex systems, which are approaches. Approaches are composed of a cluster of principles related to the same topics, building a more complex structure. Approaches are also broader from a semantic point of view, and we systemised them within three dimensions of sustainable development. Sub-systems represent part of a more complex sustainable system and consist of interlined principles and approaches. Sustainable systems consist of a cluster of interdependent and interlinked sub-systems that form a broader concept and represent more complex activities needed to achieve sustainable development. We listed sustainability or sustainable development on the top vertex as an ultimate global society goal.

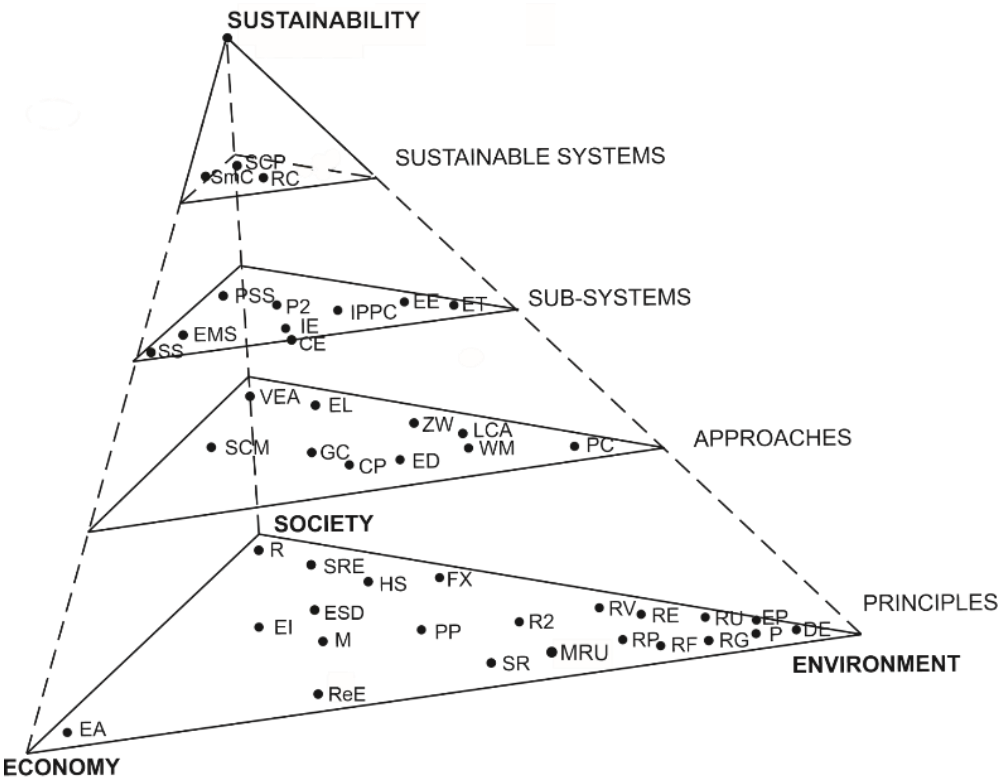


Figure 3. Classification of sustainability-oriented programmes/courses (modified from [31,69]). Abbreviations: CE, circular economy; CP, cleaner production; DE, degradation; EA, environmental accounting; ED, eco-design; EE, environmental engineering; EI, ethical investment; EL, environmental legalisation; EMS, environmental management strategy; ESD, education for sustainable development; ET, environmental technology; F*X*, factor *X*; GC, green chemistry; HS, health and safety; IE, industrial ecology; IPPC, integrated pollution prevention and control; LCA, life cycle assessment; M, mutualism; MRU, minimisation of resource usage; P, purification; PC, pollution control; PO, policy; PP, "polluter pays" principle; PSS, product service system; P2, pollution prevention; RC, responsible care; R, reporting to the stakeholders; RE, recycling; ReE, resource efficiency; RF, remanufacturing; RG, regeneration; RP, repair; RU, reuse; RV, recovery; R2, renewable resources; SCP, sustainable consumption and production; SCM, supply chain management; SD, sustainable development; SmC, smart city; SP, sustainable production; SR, source reduction; SRE, social responsibility; SmS, smart specialisation; VEA, voluntary environmental agreement; WM, waste minimisation; and ZW, zero waste.

To explain the classification, we chose the term "waste minimisation" (WM). WM is in the approach level and comprises source reduction and recycling. It is environmentally oriented, referring to industrial performance. Furthermore, it indirectly refers to human health (reduction of waste toxicity), followed by safety. By definition, WM corresponds to cost and risk reduction. WM further assembles environmental engineering and environmental technology at the sub-system level (Glavič and Kovačič Lukman, 2007).

After identifying sustainability-oriented courses and topics, three evaluators and experts (authors) independently carried out a systemisation and classification of courses and contents, based on the pre-defined framework (see Figure 4). If deviations emerged, the authors carried out a consensus review of these deviations.

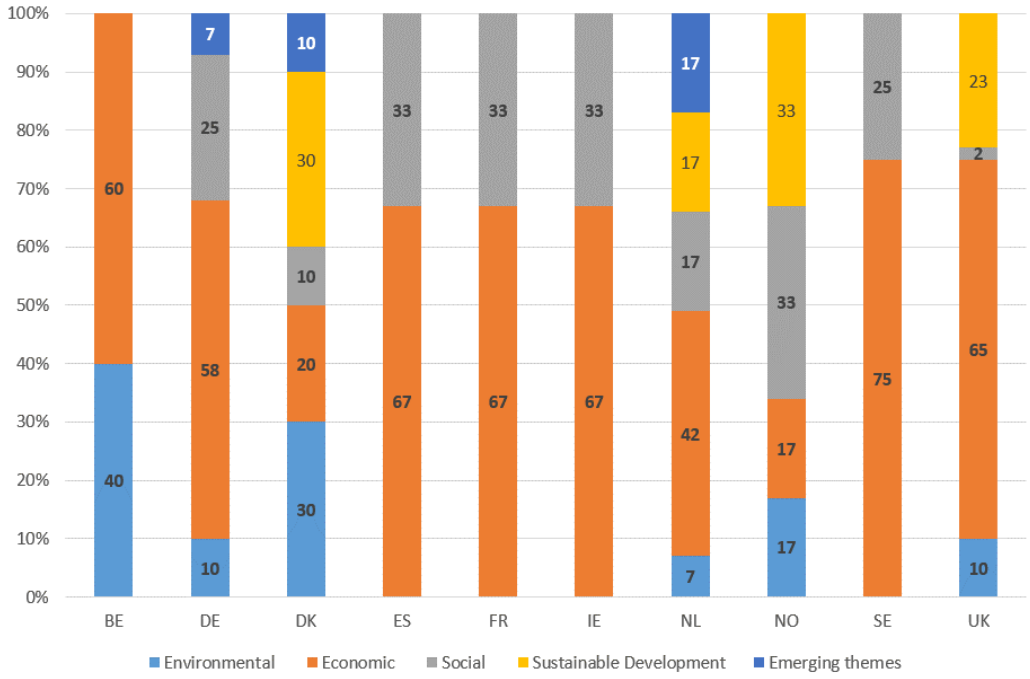


Figure 4. Clusters of subjects (in %) in different countries.

Following the suggested classification, we organised identified sustainability courses in the logistics-related programmes from two perspectives:

(1) systems
(2) horizontal dimensions

Thus, we diversified the sustainability-oriented courses from two perspectives: systemic and topical. We listed identified courses within five systemic levels, comprising principle, approach, sub-system, system, and sustainability. We differentiated the recognised courses within five theme clusters regarding the topics covered, corresponding to horizontal sustainability dimensions: environmental, economic, and social. We added two additional topical dimensions—"sustainable development" to cover complex sustainability topics, which are general, interdisciplinary, and multi-dimensional (e.g., introduction to sustainable development), and "emerging themes," where we examined new research and educational fields, such as sustainable consumption and production, smart cities, smart specialisation, circular economy, innovations in logistics, etc. We examined the emerging themes to elaborate on the educational programmes' flexibility and courses if following up with the existing research novelty and trends. We also carried out a distribution of the courses between European countries to identify their higher education systems' directions.

3.3. Identifying Pedagogical Approaches

Our in-depth research of syllabuses and courses descriptions gave special attention to identifying pedagogical and teaching approaches, following Lozano et al.'s [30] framework of 12 pedagogical approaches. These approaches comprise case studies, interdisciplinary team teaching, lecturing, mind and concept maps, project- or problem-based learning, community service learning, jigsaw/interlinked teams, participatory action research, eco-justice and community, life cycle assessment or supply chain analysis, and traditional ecological knowledge. The authors Lozano et al. [30] also elaborated in depth on the listed approaches.

4. Results

We have 34 European universities, comprising 46 bachelor's and master's logistics programmes (see Appendix A), and identified 117 sustainability-oriented courses. We structured the results into sub-sections. Firstly, we elaborate on sustainability-oriented courses, based on their syllabuses and descriptions, following the framework developed by Glavič and Kovačič Lukman [31]. Then we discuss the pedagogical approaches identified, following the modified structure of Lozano et al. [30].

4.1. Sustainability-Oriented Courses within the Logistics Programmes

A dispersion of courses among five systemic levels (see Table 4) disclosed that half of the sustainability courses encompass the "approach" level (51%), followed by "principle" (20%), sub-system (12%), systems (9%), and sustainability (8%).

Table 4. A distribution of sustainability-oriented courses in logistic programmes, classified into five systemic levels.

Systemic Levels	No.	Fraction (in %)
Principles	23	20
Approaches	60 *	51
Sub-systems	15 *	12
Systems	11	9
Sustainability	9	8
Total	117	100

* Within "emerging topics" we perceived two courses at the approach level and four at the sub-systems level.

We also analysed a horizontal dimension of "sustainable development" encompassing five subject clusters, depending on the themes they cover within their content (course syllabuses or description). Table 5 indicates a fraction of these subject clusters in the logistics-related programmes examined. We can observe that the majority of sustainability-oriented courses pertained to economic themes (54%), followed by sustainable development (17%), social (12%), environmental ones (12%), and emerging topics (5%). These outcomes suggest that logistics-oriented programmes follow the trends in their curricula, introducing sustainability and new innovative topics to their students.

Table 5. A distribution of sustainability-oriented courses within the subject clusters in the logistics programmes.

Subject Themes	No.	Fraction (in %)
Environmental	14	12
Economic	63	54
Social	14	12
Sustainable development	20	17
Emerging topics	6	5
Total	117	100

4.2. Topics Covered within the Sustainability-Oriented Courses in the Logistics Programmes

In this sub-section, we represent the sustainability topics that we perceived within the identified courses. We arranged the results per subject cluster.

In the "environmental" subject cluster, we identified 14 courses (see Table 6). The most representative was the "principle" level, covering topics such as introducing environmental impacts, environmental pollution, and renewable resources concerning the transport sector and logistics. Courses at the "approach" level comprised life cycle impact assessment and waste management. In contrast, a course at the "sub-system" level was from the content perspective more comprehensive, encompassing not only an introduction to the impacts but also their mapping and a global ecosystem perspective.

Table 6. A view of the environmental subject cluster and its topics.

Courses	Topics Identified	No.	Fraction (%)
"Principle" Level			
Environmental impacts, issues	Environmental degradation, greenhouse gas (GHG) emissions, air pollution, noise pollution, minimisation of resource usage, potential solutions, calculating GHG emissions, climate impacts, resource efficiency	6	43
Renewable resources	Renewable energy and power market, efficient use of renewables related to transport sector, supply of renewable energy sources	4	29
"Approach" Level			
Waste management	Waste management and logistics, also green logistics	1	7
Life cycle assessment	Life cycle assessment, life cycle concept	2	14
"Sub-system" Level			
Wildness and global ecosystems	Mapping environmental impacts, global ecosystems	1	7
Total		14	100

In the "economic" subject cluster, we perceived courses at the "approach" and "sub-system" levels, as shown in Table 7. The most frequent courses at the "approach" level were supply chain management (74.5%), followed by environmental management (8%). The incidence of other courses e.g., managing global supply chains and operations in supply chain management, supply chain design/planning, and supply chain technology, was less than 5%. It is essential to notice that supply chain management and similar courses are very traditional and core subjects for logistics programmes, introducing specialised knowledge and competencies. Indeed, we identified several "greener" and more sustainability-oriented topics embedded within, such as supply chain management (SCM) and challenges concerning the environment or sustainability requirements shaping supply chains.

Table 7. A view of the economic subject cluster and its topics.

Courses	Topics Identified	No.	Fraction (%)
"Approach" Level			
Supply chain management and logistics	Fundamental concepts of supply chain management, supply management, inventory management, production management, types of supply chains, customer strategy, logistics and production management, internal and inter-company planning, optimisation, product and project management, fiscal systems, SCM and green logistics, supply networks, SCM and challenges concerning the environment, advanced supply chain management, supply chain, logistics decisions, using sustainability issues for supply chain management	47	74.5

Table 7. *Cont.*

Courses	Topics Identified	No.	Fraction (%)
Managing global supply chains	Issues on global supply chain management, the implication of a "green" supply chain in global trading, managing global supply chains	3	5
Supply chain planning/design	Supply chain design, distribution network design, SCM planning	3	5
Operations in supply chain management	Analysing, modelling, optimisation, improving logistics processes in supply chains, quantitative methods to problem solutions, sustainability and its impacts on supply chains, changing ethical and sustainable behaviour (consumers)	1	1.5
Strategic supply chain management	Supply chain strategy, strategic network, coordination in supply chain networks, sustainability requirements shaping supply chains	2	3
Emergency supply chain management	Emergency, humanitarian supply chain management, supply chain management in humanitarian context, activities and resources involved in disaster relief and logistics	1	1.5
"Sub-system" Level			
Environmental management	"Green" practises in supply chains, adoption of environmental practises, environmental management planning, environmental responsibility, ISO 14000, ISO 26000, life cycle and value chain	5	8
Supply chain technology	Technological aspect of logistics and supply chain processes	1	1.5
Total		63	100

The social cluster comprised 14 courses, where courses belonged to the "principle" and "sub-system" levels (Table 8). The most dominant courses were business ethics-related (64%), followed by health and safety (21%).

Table 8. A view of the social subject cluster and its topics.

Courses	Topics Identified	No.	Fraction (%)
"Principle" Level			
Business ethics	Ethics and morality of businesses, corporate social responsibility, ethical consequences of transport, ethics, ethical travel, ethical consequences in global perspective, ethical risk regarding the food supply chain, ethical problems to societal aspects of transportation systems, moral obligations in businesses, ethical issues in companies, ethical decision-making in companies	9	64
Health and safety	Health and safety at work, the goals of health and humanitarian systems and logistics, stakeholders in the health and humanitarian systems	3	21
Global migration and uneven development	Migrations, gender issues, poverty, unequal mobility, migrations and displacements	1	7
"Sub-system" Level			
Environmental policy	Decision-making process related to environment and logistics, policy perspectives, global policy directives (e.g., United Nations)	1	7
Total		14	100

Within our analysis, we perceived 20 sustainability courses (Table 9) at two systemic levels, "system" and "sustainability." The most frequent courses were sustainable supply chain, followed by sustainability in/for businesses.

Table 9. A view into the sustainable development subject cluster and its topics.

Courses	Topics Identified	No.	Fraction (%)
"System" Level			
Sustainable logistics	Challenges in sustainable transport, sustainability and transport, sustainability theory and practise, sustainable maritime logistics, sustainable transport, sharing economy	3	15
Sustainable supply chain	Sustainability in supply chains, product design, sustainable consumption and production, beyond end-of-life product stewardship, importance of sustainability in improving business performance, sustainable practises in manufacturing and service operations, sustainable and resilient supply chains, managing sustainability in multi-tier supply chains, paradoxes and tensions in sustainable supply chain management	7	35
Sustainability in management	UN Sustainable Development Goals, sustainability strategies, sustainable business models	1	5
"Sustainability" Level			
Sustainability in/for businesses	Sustainable development in businesses, determining to which extend the business is sustainable	4	20
Urban sustainability	Sustainable urban development, urban spatial form and role in accommodating sustainable growth, sustainable development and its critiques, assessing sustainability, sustainable building and sustainable urban development	3	15
Sustainable development	Sustainable development; social, economic, environmental, cultural, and political perspectives; climate change, energy transition	2	10
Total		20	100

The emerging topics subject cluster comprised 5% of the courses, all at the "subsystem" level, and it covered two courses:

(a) Circular economy-related courses covering topics such as circular economy, triple bottom line, and closed loops supply chains, and
(b) Innovations-related courses, covering topics as innovations and sustainable energy, success and failure factors in innovations, supply chain innovation processes, life cycle of technology innovations, and emerging technologies.

Figure 5 represents a fraction (in %) of subject clusters per country. It is vital to notice that we considered only universities within the Top 200 ARWU. Consequently, we included only 10 European universities in our study. As can be seen from Figure 4, only Dutch and Danish universities offered courses within all the subject clusters in the logistics programmes, followed by German, Norwegian, and British universities. The incidence of environmental courses at logistics programmes varied among the best European universities from 40% in Belgium to 0% in Spain, France, and Ireland. Most universities emphasised the economic subject cluster in logistics programmes, except for Danish universities, which devoted more courses to environmental and sustainability themes, and Norwegian universities, which highlighted social and sustainability topics. We perceived emerging themes at universities in three countries: Germany, Denmark, and the Netherlands.

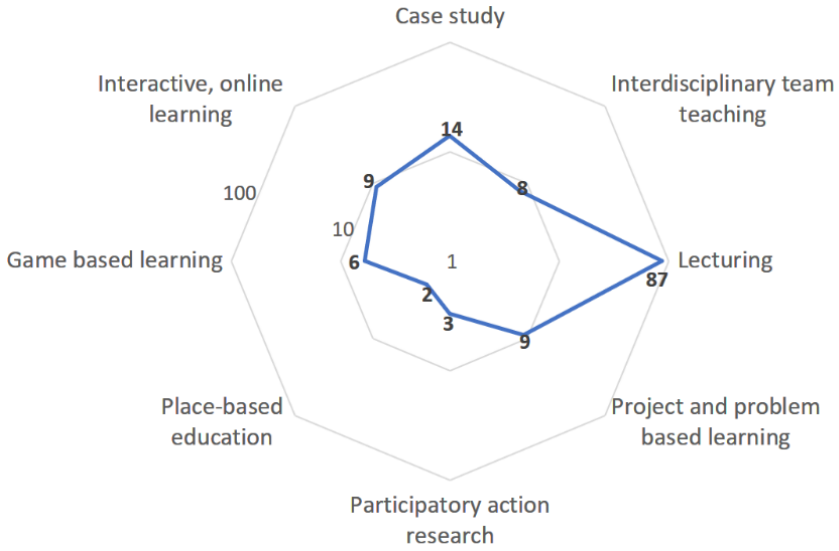


Figure 5. Pedagogical approaches used, considering a framework from Lozano et al. (2017).

4.3. Pedagogical Approaches

We noticed pedagogical approaches in 92 (78%) of identified courses and arranged them in Table 10 In 8.7% (8) courses, we identified only lectures as a teaching method. Predominantly (in 65.2%), sustainability-oriented courses in the logistics programmes were taught using a combination of three or more pedagogical approaches, e.g., lectures supported by exercises, case studies, and self-study, or lectures supported by project work, simulation games, and self-study.

Table 10. Pedagogical approaches used by the sustainability-oriented courses in logistics-related programmes.

Pedagogical Approach	No.	Fraction (in %)
Single Teaching Approaches	10	10.8
- lectures	8	8.8
- independent research	1	1.0
- assignments	1	1.0
Dual Teaching Approaches	22	24.0
- lectures and self-study	6	6.6
- lectures and seminars/workshops	3	3.3
- lectures and group project/group work	7	7.7
- lectures and exercises	3	3.3
- interactive lectures and practical work	1	1.0
- Lectures and tutorials	2	2.1
Multiple Teaching Approaches		
- Lectures, exercises, tutorials, case studies, self-study, online learning, interactive learning, practical industry case studies, problem-solving activities, workshops, seminars, simulation games, group project work, scientific reports, project team with an external company, guest speakers, real business cases, research	60	65.2

We followed the framework by Lozano et al. (2017), and modified it by adding two additional issues, game-based learning and interactive online learning, as shown in Figure 5. Traditional learning approaches (lecturing, case studies, team teaching, problem-based learning) were most frequently employed. However, we perceived some new and innovative teaching methods, such as game-based or interactive simulations and online learning. However, we did not identify any transformative learning approaches. It is essential to emphasise that we carried out the study during the European "lockdown" period of COVID-19, when most universities switched from traditional to online learning

approaches, and thus, Figure 5 does not necessarily reflect this. We sourced the pedagogical approaches from the course syllabuses, which universities did not update.

5. Discussion

In this study, we examined the integration of sustainability-oriented courses into logistics-related programmes at the best European universities. The topics of sustainability education has been widely acknowledged in the scientific community. Over 600 papers were published in WoS since 2015, and publications in this field have an increasing trend.

Although the concept of diverse sustainability courses and topics within the programmes is prerequisite, according to the definition of sustainability, our research reveals moderate course diversity from the system perspective and horizontal dimensions. Our results are compliant and support previous studies on the diversity of sustainability topics, e.g., Friman et al. [50], who elaborated on sustainable development topics covered by Brazilian and Finnish programmes, and Stough et al. [70], who identified seven diverse sustainability topics at the university in Leuven.

Regarding the system perspective, numerous courses within the "principle" and "approach" levels (71%) signified a wide range of specialised courses with narrow and in-depth topics, assuring expertise competencies and knowledge. We also perceived "sustainability" level courses (8%) that offered a study of introductory, holistic, complex, and general sustainability topics, which from the content perspective assures multi-, inter-, and trans-disciplinary knowledge and competencies. However, logistics-related educational programmes should include sustainability topics at the highest system level (especially as horizontal or core courses), because the primary focus of logisticians is managing and controlling supply chains, within or outside businesses and companies. This requires a broad system perspective, general knowledge and competencies, and understanding of complex systems and related impacts on environmental, economic, and social dimensions. These issues will enable future logisticians to understand, manage, and solve real-world challenges of supply chains beyond the economic discipline, as we cannot neglect logistics processes' environmental and social consequences. Furthermore, logistics education should emphasise cross-functional and cross-disciplinary aspects and address future challenges and evolving logistics areas [28,71–73].

Considering the horizontal dimensions, our study indicated that the most frequent were the subject cluster belonging to "economics" topics. This issue was expected, as logistics programmes have their roots in economics, management, and business education programmes. Wu [24] reported that logistics education closely relates to business and management programmes and that transportation can no longer cover logistics educational needs. The most common course within the economic group was supply chain management, whose incidence was 74.5%. Stock and Lambert [74] claimed that supply chain management is the most typical logistics management course. The second-largest incidence within the logistics programmes was "sustainability" topics (17%). Surprisingly, we identified sustainability topics within traditional logistics courses, such as supply chain management. However, from the course syllabus and description, it was impossible to evaluate the fraction of these topics within the whole course. Thus, we could not argue how in-depth the topics were discussed within the individual course or whether they were only briefly mentioned. The incidence of sustainability topics within the courses increased the "occurrence of sustainability topics" to 17%. We can compare Porras Álvarez et al.'s [33] outcomes, where the authors indicated an occurrence of sustainability courses of between 5 and 25% in architecture programmes. Our results also revealed a better integration of sustainability topics into logistic programmes than into the technology [40], chemical and environmental engineering [9], tourism [38], and urbanism [36] programmes. Our study shows a divergence from the outcome of Filho et al. [17], where the authors claimed a scarcity of sustainability integration within the universities' programmes. We can correlate a better integration of sustainability topics within our study with the fact that we examined

only the best European universities. As discussed by Hart et al. [39], the best schools are more likely integrating sustainability-oriented courses and topics.

Both the "environmental" and "social" subject clusters within logistics programmes had the same frequency (12%). When comparing logistics programmes against engineering ones [9], we perceived that engineering programmes significantly included environmental topics, whereas logistics merely introduced them. Our study was also in line with the findings in [35] regarding less integration of social issues within sustainability courses. In addition, within the "social" subject cluster, we mostly perceived courses related to ethics, followed by health and safety. However, a need exists to introduce other topics within this subject cluster, which would offer students more complex knowledge and skills on social issues, including topics such as environmental law and sustainability policy.

The research results indicated that the least frequent subject cluster was "emerging themes" (5%), covering circular economy and innovation-related topics. We can infer that in general, logistics study programmes across Europe are not flexible enough to follow the recent research and development trends, except for the universities in the most developed and innovative European countries, such as Germany, Denmark, and the Netherlands. However, we perceived a similarity from the country perspective between logistics and engineering programmes. In addition, in the engineering study programmes, Dutch universities are the ones following the most contemporary research and development.

To sum up, for logistics students, it should be essential to acquire not only the basic theory and practise but also encourage thinking processes and the transformation and creation of new and innovative knowledge, structures, and processes. The integration of sustainability into the educational process should start with introductory sustainability courses, which are essential for understanding the holistic view (e.g., stainability and logistics) taught as a standalone course. More in-depth topics based on the principles and approaches of sustainable development, representing a decisive step towards systemic and holistic thinking, shall be introduced, and preferably horizontally integrated into existing courses. It is essential to mention that logistics education cannot cover all the principles or approaches, especially those beyond the discipline's scope (e.g., environmental accounting or environmental engineering).

When introducing sustainability into logistics-oriented programmes, a plethora of pedagogical approaches exist, and multiple are employed within the identified courses. Our study suggested that lectures remain the most common pedagogical approach, which is in line with the survey in [30]. However, understanding and practising sustainability at the system level requires transformative learning practises, as exposed by [63]. For the systems level, lecturing is not an effective or efficient approach. We cannot expect to gain a more in-depth understanding of complexity when "telling" is a presiding pedagogical tool [63]. In addition, van Hoek [75] discussed the risks of employing only lectures, as innovations, practise, and case studies are usually kept out. In transformative learning, the lecturer becomes a facilitator, fostering critical thinking and reflections and giving students the possibility for efficient and effective participation, including assessing beliefs and values [76,77] and reconsidering sustainability challenges from various perspectives, with critical self-reflection. Gravier and Farris [25] identified problem-based learning approaches as dominant in logistics education, which in our case consisted of 10% of courses. Gravier and Farris [25] further discussed that case studies might not be the most appropriate pedagogical approach as they do not provide in situ practical work. However, it is favourable that in our study more than 10% of the courses comprised innovative pedagogical approaches, such as game-based learning, which was proposed as a useful approach to improve students' engagement in learning [30].

Regarding which pedagogical approach is more suitable for courses/topics at different system levels, we do not define it as a standardised or one-size-fits-all procedure, but rather as a mix of various approaches. When students are introduced to the topic without any previous background, lectures might be valuable for the initial hours, and later supported

with case studies, problem-solving, place-based education, game-based learning, and other innovative approaches.

6. Conclusions

We analysed and elaborated on the integration of sustainability topics within existing logistics-oriented bachelor's and master's programmes at the best European universities and emphasised pedagogical approaches. Our results demonstrated the most commonly used sustainability-oriented courses within logistics-related programmes and gaps and challenges to overcome to deliver comprehensive sustainable development knowledge, skills, and competencies to future logistics professionals.

In our study, we perceived a moderate diversity of courses from the systems and horizontal perspectives. From the systems perspective, courses mostly focus on the "principle" and "approach" levels (71% of courses), denoting numerous specialised courses in logistics programmes. A horizontal perspective identifies many economic courses (54%) and topics, showing that logistics programmes remain loyal to their origin and tradition, with fewer environmental and social topics. Such coverage and distribution might imply a limitation to developing complex, multi-dimensional, and inter-disciplinary understanding, thinking, and problem-solving required for real-world challenges, as we identified only 8% of sustainability courses comprehending all the dimensions. To fill this gap, universities should upgrade and enrich their study programmes with sustainability at the highest systems level, integrating general and introductory courses in the first year of study, followed by more in-depth topics and nursing sustainability understanding and competencies throughout the whole study programme. A sustainability topic integration (also within the courses) might be promising (17%). Based on this, we can argue that logistics-related programmes are in the mature stage of sustainability integration compared to engineering, science, urbanism, and tourism programmes and that progress regarding sustainability integration has been made.

We perceived less flexibility of logistics-related programmes within our results in introducing new and emerging topics. Thus, study programmes need more frequent revisions to prepare students for future challenges that follow current global research and development trends. We also perceived an innovativeness scarcity in the usage of pedagogical approaches when teaching sustainability-oriented topics. Most of the courses emphasised traditional pedagogical approaches, such as lectures, case studies, project- and problem-based learning, and a paradox about efficient and effective transformative sustainability learning remains.

The novelty and added value of this paper lie in providing the first empirical evaluation and elaboration of logistics programmes at European universities from a sustainability perspective. Thus, our study enriches current knowledge and research on sustainability integration into curricula at the university level, enabling new insights and better correlations between various study fields and pedagogical approaches used. As scientific literature indicates, researchers have extensively discussed architecture, tourism, and engineering/technology programmes.

Our study's outcomes are useful for curricula designers in logistics programmes and researchers that are focusing on sustainability inclusion in existing programmes or generating new ones. Course evaluations from the systemic perspective are beneficial when designing core curricula with compulsory courses as well as elective courses, which should be more specialised and oriented toward the "principle" or "approach" levels. This paper's outcomes also give opportunities for logistics-related programmes to modernise and improve from the content and pedagogical approach perspectives.

Nevertheless, we should address some limitations of our study. A first limitation is the number of universities considered, as we focused on the Top 200 Universities on the ARWU ranking lists, which only include scientific ranking indicators. Thus, in our survey, we considered only top European institutions, which is also a limitation of a geographical nature. Consequently, our results cannot be generalised to all the logistics programmes in

Europe, as top universities most likely intend to include sustainability topics. However, based on our study and results, universities with logistics programmes listed outside the top 200 might require individual comparison and an examination of their integration of sustainability and pedagogical approaches used, significantly contributing to the novelty or harmonisation of their study programmes. Another limitation relates to the content of the courses, which we sourced from the syllabuses or course descriptions, where we identified the topics covered, but not how in-depth the topics are discussed within the individual course or if they only briefly mention sustainability, and how many teaching/learning hours within the course are devoted to such topics. Future research will complete a survey on integrating sustainability issues into logistics education to overcome these limitations, notably by expanding the number of universities and geographical regions. In addition, questionnaires for individual lecturers of the identified courses could deepen the study results, bringing insights about the actual level of topics covered, teaching approaches, and teaching and learning materials used. Further research on the effectiveness and efficiency of various pedagogical approaches might be interesting, as the "lockdown" period caused many changes in the overall educational sector.

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Appendix A

Table A1. Universities included in our study at which we identified sustainability-related courses.

University	Faculty/Department
Technical University Munich	TUM School of Management—Logistics and Supply Chain Management Department (BSc)
Technical University Dresden	Faculty of Transportation and Traffic Sciences—Transport Economics (BSc)
University of Warwick	Faculty of Science, Engineering and Medicine—Warwick Manufacturing Group (W.M.G.)—(MSc) Supply Chain and Logistics Management
Cardiff University	Cardiff Business School—Business Management (Logistics and Operations) (BSc), Cardiff Business School—Logistics and Operations Management (MSc)
University of Exeter	College of Engineering, Mathematics and Physical Sciences—Engineering—(MSc) International Supply Chain Management
University of Southampton	Southampton Business School—(MSc) Supply Chain Management and Logistics
University of Nottingham	Nottingham University Business School—Operations Management—Supply Chain and Operations Management (MSc), Logistics and Supply Chain Management (MSc)
University of Liverpool	Faculty of Humanities & Social Sciences—Management School—Operations and Supply Chain Management (MSc)
University of Leeds	Faculty of Business—Management—Global Supply Chain Management (MSc), Geography with Transport Studies (BSc)

Table A1. *Cont.*

University	Faculty/Department
The University of Sheffield	Management School—Logistics and Supply Chain Management (MSc)
Cardiff University	Cardiff Business School—Logistics and Operations Management (MSc); Sustainable Supply Chain Management (MSc)
University of Bristol	School of Economics, Finance and Management—Department of Management—(MSc) Global Operations and Supply Chain Management
The University of Manchester	Alliance Manchester Business School—(MSc) Operations, Project and Supply Chain Management
Lund University	Faculty of Engineering LTH—Logistics and Supply Chain Management (MSc)
University of Gothenburg	School of Business, Economic and Law—Logistics and Transport Management (MSc)
University of Barcelona	Institut de Formació Contínua—Integrated Supply Chain Management (MSc)
Norwegian University of Science and Technology—NTNU	Faculty of Engineering—Logistics Engineering—(BSc); Shipping Management (BSc), Logistics (BSc)
University of Groningen	The Economics and Business Faculty—Supply Chain Management (MSc)
Erasmus University Rotterdam	Rotterdam School of Management—Supply Chain Management (MSc), Operations Research and Quantitative Logistics (MSc), Urban, Port and Transport Economics (MSc)
VU University Amsterdam	School of Business and Economics—Spatial, Transport and Environmental Economics (MSc)
University of Wageningen	Agrotechnology and Food Sciences—(MSc)—Specialisation: Supply Chain Safety
Delft University of Technology	Faculty of Technology, Policy and Management (MSc) Transport, Infrastructure and Logistics
Trinity College Dublin	Trinity Business School—Operations and Supply Chain Management (MSc)
University of Wuerzburg	Faculty of Business Management and Economics—Chair of Logistics and Quantitative Methods—(MSc)
University of Muenster	Department of Information Systems—Chair for Information Systems and Supply Chain Management (MSc); Supply Chain Management (BSc)
University of Hamburg	Faculty of Business Administration—Institute for Logistics and Supply Chain Management (BSc)
University of Cologne	Faculty of Management, Economics and Social Sciences—Business Administration—Supply Chain Management (MSc); Supply Chain Management (BSc)
University of Goettingen	Production and Logistics (MSc)
Université Grenoble Alpes	Faculty of Law, Economics and Management—Production Management, Logistics, Purchasing (MSc)
Aarhus University	School of Business and Social Sciences—Operations and Supply Chain Analytics (MSc)
Technical University of Denmark	Transport and Logistics (MSc)
KU Leuven	Faculty of Engineering Science—Logistics and Traffic (MSc)
Université libre de Bruxelles (ULB)	Polytechnic School of Brussels—Transport and Logistics (MSc)

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