

## Chapter #1

# EDUCATIONAL STRATEGIES IN SUSTAINABILITY ECONOMICS

## Empowering change through education

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### ABSTRACT

This chapter looks at different ways to consolidate Sustainability Economics in the curricula of undergraduate and graduate economic-related education levels so as to enhance the knowledge and analytical skills they need to successfully address sustainability-related issues. Proposals are guided by four key principles – interdisciplinary perspectives, critical thinking, experiential learning, and collaboration with stakeholders –, and are aligned with the Dublin Descriptors' guidelines. The suggested multi-faceted educational approaches include integrating specific sustainability contents into the curriculum, using problem-based learning approaches, providing experiential opportunities, and facilitating interdisciplinary collaboration and community engagement. Anticipated outcomes include a more comprehensive understanding of economic principles related to sustainability, increased awareness of economically sustainable practices, and improved proficiency in policy evaluation. The ultimate goal is to devise educational approaches in Sustainability Economics at the undergraduate and graduate levels capable of better empowering students to make informed decisions for a more sustainable future.

*Keywords:* sustainability economics, education for sustainability; academic curriculum.

## 1. INTRODUCTION

Climate change, resource depletion, animal extinction, and other adverse effects are depicted in the *Anthropocene* (UNDP, 2020) as a result of some modern societies' production and consumption practices. The current critical situation is a reminder of the need to reassess our practices. However, a one-sided perspective on the problem is insufficient. A comprehensive approach is necessary to change the Anthropocene trajectory (Baumann, 2021). Indeed, in a context of *(poly)crisis* (Morin, 2011; Tooze, 2022), mankind faces a moment of truth, which can be one of confrontation with the end or of opportunity for change. Humanity does have the option to make different choices.

In this scenario, Education, and Education for Sustainability in particular, are essential for empowering people to become responsible, active global citizens who can contribute to a more sustainable world (Ohlmeier, 2015; Schroer, Lowman, & Just, 2015). Although Science Education is well suited to impart the vital knowledge, skills, and values essential for making informed decisions towards achieving a sustainable future for our planet (Taylor, Taylor, & Chow, 2013), educating for sustainability carries great importance across various learning domains of the social sciences (Gadotti, 2010). The study of Economics is particularly important for understanding the dimensions of sustainable behavior, evaluating the effects of environmental conservation policies, and managing the challenges of creating a sustainable global economy within a capitalist framework (Bartelmus, 2010; Wijethilake & Upadhaya, 2020).

This chapter looks at ways to consolidate Sustainability Economics into undergraduate and graduate curricula related to economics. The aim is to cultivate a more thorough awareness of sustainable economic practices and suggest educational approaches that may empower future citizens with the knowledge for consistent Sustainability Economics decision-making, thus setting the course for a more sustainable future.

## 2. PERSPECTIVES AND DEBATES IN SUSTAINABILITY ECONOMICS

In the face of growing global environmental tribulations, Sustainability Economics has taken center stage, engaging economists who seek to untangle the complex interactions between human activities and the environment. Several authors offer diverse perspectives on Sustainability Economics, addressing its usability, characteristics, and scope, calling for an integrated approach that considers ecological, social, and economic dimensions to effectively address contemporary sustainability challenges.

O'Hara (1995, p. 111) critiques the multiple, narrow, and often conflicting definitions of sustainable economic development within economic theory and argues that "to reframe the relationship between production and sustainability as compatible rather than adversarial requires a broadening of theory, inquiry, and methodology." For this conceptual expansion, he proposes three essential principles: emphasizing concreteness rather than abstraction, connectedness rather than isolation, and diversity rather than homogeneity. Complementarily, Seghezzi (2009) challenges the traditional understanding of sustainability and proposes a conceptual framework with five dimensions: "place" (which encompasses three spatial dimensions), "persons" (the human dimension), and "permanence" (the temporal dimension), thus offering a more comprehensive view of sustainability and development.

Söderbaum (2022, p. 2) focuses on the ecological dimension and proposes Sustainability Economics (read as 'Ecological Economics') as an alternative or complement to neoclassical economics, thus moving from the theoretical limits of efficient allocation of scarce resources to "multidimensional management of resources in democratic societies where the expected interests of future generations are taken seriously." Ayres (2008) contends that Sustainability Economics should integrate resource and environmental economics, addressing economic growth while mitigating pollution and fossil fuel consumption and considering challenges like climate change and energy supply. He sees Sustainability Economics as a multidimensional field that goes beyond the traditional confines of Environmental Economics, and emphasizes a comprehensive approach that systematically incorporates ecological, social, and economic considerations under the Sustainability Economics framework, providing a normatively rooted vision for managing the intricate relationships between humans and nature.

Baumgärtner and Quaas (2010) also present Sustainability Economics as an evolving concept that systematically integrates ecological, environmental, and resource economic considerations. They focus on the relationship between humans and nature, acknowledging an inherently uncertain future and taking a long-term perspective with a normative foundation rooted in the principles of justice among present and future generations and a commitment to economic efficiency in the allocation of natural resources. Bartelmus (2010) also presents Sustainability Economics as the merging of economic efficiency and justice. Accordingly, he argues for a quantifiable sustainability concept through environmentally modified national accounts, emphasizing sustainable economic performance and growth.

Quental, Lourenço and da Silva (2011) identify four key sustainability principles, incorporating insights from Ecological Economics, sustainability transition, and sustainability science: biophysical limits that constrain the economy, a focus on societal welfare and development, the existence of minimum irreducible needs, and system complexity. Mensah (2019) is more concerned with inter- and intragenerational equity anchored on three interconnected pillars: environment, economy, and society. He stresses the importance of considering interconnections, synergies, and compromises among these elements and calls for substantial actions from key players (such as the United Nations, governments, the private sector, and civil society organizations) to promote sustainable resource management at multiple levels in terms of policies, education, and regulations on social, economic, and environmental resource management. These actions are deemed crucial to fostering widespread awareness and compliance with the principles of sustainable development.

These diverse perspectives reveal only a few of the ongoing debates within Sustainability Economics, addressing the balance between economic efficiency, justice, and environmental considerations. Indeed, for years, many influential scholars have enriched the discourse on Sustainability Economics from varying perspectives. Hardin (1968) discussed resource management and sustainability. Schumacher (1973) advocated for human-scale, decentralized technologies and sustainable development. Georgescu-Roegen (1986) strongly influenced ecological economics. Ostrom (1990) provided valuable insights into the sustainable management of natural resources, focusing on common-pool resources and institutional analysis. Daly (1996) extensively discussed ecological economics and the complexities of sustainable development. Costanza et al. (1997) focused on ecological economics, valuing ecosystem services, and promoting sustainability. Schor (1999) explored the relationship between work, consumption, and sustainability and related it to economic systems and environmental sustainability. Sen (1999) left an indelible mark on discussions surrounding sustainable development, with an emphasis on social justice. And Jackson (2009) discussed the intricate relationship between economic growth and sustainability.

Other noteworthy contributions to the practical application of economic principles to address sustainability challenges include the seminal contributions of Ostrom (1990; 2009) in sustainable resource management, Nordhaus's (1994; 2019) investigations into the costs and benefits of climate policies, and Romer's (1990) research on innovation and technological progress fostering sustainable economic development. These recognized works, acknowledged by laureates, exemplify the effectiveness of applying economic principles to address sustainability concerns.

Collectively, all the above contributions significantly added to the theoretical foundations of Sustainability Economics. However, despite sharing elements such as integrating ecological, social, and economic considerations and emphasizing long-term perspectives, Sustainability Economics exhibits discrepancies in the importance given to justice, efficiency, conceptual framework dimensions, and the role of economic growth. These differences, however, contribute to the dynamic, multifaceted nature and comprehensiveness of Sustainability Economics.

For the purpose of this chapter, we choose to follow the direction provided by Baumgärtner and Quaas (2010) and again by Drupp, Baumgärtner, Meyer, Quaas, and von Wehrde (2020) after a systematic examination of the development and state of Sustainability Economics between 1987 and 2013, and adopt a four-dimensional characterization: (i) a subject matter focus on the human-nature relationship; (ii) orientation to the long-term and uncertain future; (iii) a normative orientation of sustainability; and (iv) a genuinely economic efficiency concern. Accordingly, Sustainability Economics is to be understood as

a multidimensional and interdisciplinary field with a genuinely economic focus that encompasses the relationship between humans and nature, adopts a long-term perspective, and prioritizes economic efficiency while establishing a normative foundation for sustainability challenges.

### **3. CRITICAL ROLE OF SUSTAINABILITY ECONOMICS EDUCATION**

The pressing global challenges facing humanity over the last several decades have highlighted the intricate interplay between environmental degradation, social inequality, and economic instability. These challenges highlight the need for comprehensive, interdisciplinary approaches that transcend traditional disciplinary boundaries and ultimately tackle issues pertaining to human rights (Vasconcelos & Vasconcelos, 2022).

As previously discussed, Sustainability Economics goes beyond environmental considerations and adopts an interdisciplinary long-term approach that prioritizes social equity and environmental responsibility over short-term economic gains, attempting to provide transformative solutions to global problems beyond the environmental sphere. While Environmental Education raises awareness and instills a sense of responsibility for environmental issues, it cannot replace education in Sustainability Economics, which provides a more comprehensive framework.

Achieving sustainability requires a fundamental cultural shift that can only be brought about through the education of sustainability-responsible citizens. In this context, education for Sustainability Economics plays a central role by empowering students with an interdisciplinary knowledge base. This knowledge enables students to grasp fundamental concepts such as Ecological Economics, social justice, common-pool resources, ecosystem services, and decentralized technologies, providing them with the competencies necessary to effectively address the complexities of sustainability challenges and actively contribute to a sustainable future. Thus, the interdisciplinary nature of Sustainability Economics aligns with the transformative vision of education for sustainability.

Educational initiatives related to Sustainability Economics foster critical thinking skills essential for analyzing and evaluating the impacts of economic decisions on environmental and societal domains. This capacity is crucial for guiding individuals towards informed decision-making aligned with sustainable practices. Simultaneously, the development of problem-solving skills in Sustainability Economics encourages creative thinking, facilitating the generation of innovative solutions to real-world challenges and favoring sustainable practices across diverse sectors of the economy. Additionally, ethical considerations in economic decision-making, emphasized in education, encourage individuals to reflect on the social and environmental impacts of economic activities, fostering values such as equity, social justice, and responsibility towards future generations. Furthermore, education actively promotes community engagement and participation, empowering individuals to contribute to local initiatives, advocate for sustainable practices, and collaborate with others to address sustainability concerns.

Ultimately, education for Sustainability Economics has to be able to exert a disruptive-transformative influence (Gadotti, 2010) by heightening awareness of the sustainability-related implications of individual decisions and deepening the comprehension of how personal choices can either support or hinder long-term sustainability, social equity, and environmental well-being. This 'transition from transmissive education to transformative education' was pointed out as a necessity and "includes elements of insight, reflection, learning in the outdoors, and learning through sustainability themes, implementing ESD [Education for Sustainable Development] in schools through a series of regional hubs with

clusters of schools in partnerships with existing tertiary institutions, government and nongovernment organizations" (4th International Environmental Education Conference, held from November 24–28, 2007 at the Center Environmental Education cit. in Gadotti, 2010, p. 206).

Given the objective of not only imparting knowledge but also fostering a sense of responsibility and awareness regarding sustainable economic issues and their interconnectedness with broader social, economic, and environmental systems, it is necessary to revise curricula to prioritize the promotion of sustainability awareness across various educational levels. This can be achieved through the implementation of diverse approaches such as interdisciplinary curriculum integration, experiential learning, technological integration, and community engagement. The following sections 4. and 5. seek to present educational approaches in order to accomplish this objective.

#### **4. METHOD**

This study adopts a qualitative method (Creswell, 2017), drawing on scholarly research and theoretical knowledge to suggest educational approaches for Sustainability Economics education.

The selection of approaches was grounded in four key premises. Firstly, Sustainability Economics adopts an interdisciplinary perspective, recognizing the need for knowledge from other disciplines in order to effectively address the intricate global issues of today. This interdisciplinary approach incorporates economic concepts with perspectives from Environmental Science, Sociology, Ethics, and several other fields, offering students a comprehensive understanding of sustainability. Secondly, critical thinking is deemed a fundamental characteristic of sustainability education. It enables students to effectively analyze the complex and multidimensional character of issues associated with sustainability and empowers them with the capacity to consider the trade-offs that come with decision-making and to develop innovative, systemic solutions. Thirdly, experiential learning is considered a crucial educational methodology within sustainability education. Engaging in activities like field excursions, internships, and community participation provides students with the opportunity to apply theoretical knowledge in practical, real-world contexts and gain a more profound and intricate comprehension of sustainability concerns and the many complexities associated with them. Fourthly, collaboration with stakeholders is considered another fundamental component of sustainability education. By fostering collaboration with communities, companies, non-governmental organizations, and government entities, educational institutions may provide a range of viewpoints, real-world experiences, a collective sense of accountability, and chances for students to actively contribute to positive transformations towards a more sustainable future. Therefore, educational institutions should prioritize fostering collaboration and engagement with relevant stakeholders, enriching the educational process, and offering practical insights into the application of sustainable practices in real-world scenarios. Based on these premises, proposals were devised to pursue a transformative role for Sustainability Economics education, drawing from over thirty years of academic and pedagogical experience in the fields of economics, macroeconomics, and development. The proposals align with the Dublin Descriptors' guidelines (Report for the Joint Quality Initiative Informal Group [RJQIG], 2004), which serve as a fundamental framework for delineating learning objectives, outcomes, and competencies across various educational levels. Additionally, consideration was given to the development of students' cognitive, practical, communicative, and problem-solving competencies at each educational level. Efforts were also directed towards assessing the degree of autonomy, the level of task complexity, and the desired learning outcomes for different stages of learning, ensuring an overall alignment of pedagogical approaches with the needs of the students involved.

Since these are general proposals, each should be adapted to the unique context and needs of the educational institution and students involved in each specific case.

## 5. PROPOSALS AND EDUCATIONAL APPROACHES

Tables 1 and 2 summarize proposals for incorporating Sustainability Economics into academic curricula through the implementation of interdisciplinary curriculum integration, experiential learning, community engagement, and the integration of sustainability principles across diverse educational levels and disciplines.

Table 1 presents an overview of educational curricula and strategies aimed at enhancing Sustainability Economics education among undergraduate economics students. Table 2 focuses on helping graduate economic-related students comprehend the intricate linkages between socioeconomic factors and sustainability while acknowledging potential challenges and limitations in the field of Sustainability Economics. The proposals in both tables benefit significantly from a review of relevant literature, which helps identify approaches, challenges, and opportunities.

*Table 1.  
Promoting Sustainability Awareness among Undergraduate Economics Students.*

Educational Strategies (ES)	Related Actions (RA)
<p><b>Main Objectives:</b></p> <ol style="list-style-type: none"> <li>1. Understanding sustainable economic concepts and practices;</li> <li>2. Promoting transformative thinking and action to foster change.</li> </ol>	
<p><b>Curriculum - Learning Topics</b> (Cassar, 2022; Eizaguirre, García-Feijoo, &amp; Laka, 2019; Lengyel et al., 2019; Novo-Corti, Badea, Tirca, &amp; Aceleanu, 2018)</p> <p><b>ES1. Sustainability Economics contents</b></p> <ul style="list-style-type: none"> <li>• <i>Sustainable development</i>;</li> <li>• <i>Environmental economics</i>: resource depletion and circular economy models; negative externalities and renewable energy sources;</li> <li>• <i>Consumer and business practices</i>: ecosystem services; corporate social responsibility; sustainable supply chains; consumption patterns.</li> </ul> <p><b>Educational approaches</b></p> <p><b>ES2.</b> Problem-based learning approaches (Natkin, 2016);</p> <p><b>ES3.</b> Experiential learning opportunities: Field trips, Applied projects (Lozano, Merrill, Sammalisto, Ceulemans, &amp; Lozano, 2017);</p> <p><b>ES4.</b> Inquiry- and Active-based learning approaches (Govender &amp; Pillay, 2022; Sierra &amp; Suárez-Collado, 2021).</p>	<p><b>RA1.</b> Invite sustainability experts and practitioners to deliver <b>guest lectures</b> and provide real-world insights and problem-solving approaches (e.g., Robina-Ramírez &amp; Luna, 2020).</p> <p><b>RA2.</b> Conduct interactive <b>workshops, seminars, and small-group roundtable discussions</b> where experts facilitate discussions, group activities, and problem-solving exercises (e.g., Leal, Azeiteiro, &amp; Aleixo, 2024; Mititelu, Fiorani, &amp; Litardi, 2017).</p> <p><b>RA3.</b> Host <b>panel discussions</b> with experts from different sectors and disciplines to provide diverse perspectives on sustainability issues (e.g., Aronczyk et al., 2022). Students can engage with panelists through Q&amp;A sessions.</p> <p><b>RA4.</b> Arrange <b>informal networking events</b> where students can meet and interact with sustainability experts informally, fostering meaningful connections and discussions (e.g., Henry, 2018).</p> <p><b>RA5.</b> Arrange <b>visits</b> to organizations, research centers, or projects (e.g., Samuel, Thomas, McGouran, &amp; White, 2022).</p> <p><b>RA6.</b> Establish <b>mentorship programs</b> that pair students with sustainability professionals, providing students with one-on-one opportunities to learn from experienced practitioners and personalized learning experiences (e.g., Birdman, Barth, &amp; Lang, 2022).</p> <p><b>RA7.</b> Integrate sustainability concepts into <b>capstone courses</b>, encouraging or requiring students to apply their knowledge to real-world problems or situations</p>

	<p>(e.g., Palacin-Silva, Seffah, &amp; Porras, 2018; Thomas, 2018).</p> <p><b>RA8.</b> Encourage students to <b>identify sustainability challenges</b> within their communities or on-campus and design and implement projects to address them, fostering a sense of ownership and responsibility.</p> <p><b>RA9.</b> Assign <b>homework</b> that requires students to investigate real-world sustainability challenges and propose evidence-based solutions, enhancing their understanding of complex sustainability issues.</p> <p><b>RA10.</b> Organize <b>challenges</b> where students work in teams to develop sustainable solutions, encouraging creativity and teamwork (e.g., Govender &amp; Pillay, 2022; Sierra &amp; Suárez-Collado, 2021).</p>
Expected Results	Challenges
<ol style="list-style-type: none"> <li>1. Increased awareness and understanding of sustainability issues. [ES1; RA1-4]</li> <li>2. Enhanced critical thinking and problem-solving skills. [ES2&amp;4; RA1-10]</li> <li>3. Real-world exposure to sustainable practices. [ES2-4; RA5-6]</li> <li>4. Improved analytical and research skills. [ES2-4; RA7]</li> <li>5. Increased sense of ownership and responsibility. [ES3; RA8-10]</li> </ol>	<ol style="list-style-type: none"> <li>1. Engaging students in practical sustainability implementation (Pearson, Honeywood, &amp; O’Toole, 2005; Rampasso et al., 2019)</li> <li>2. Addressing students perceptions of economic growth vs. environmental protection (Müller, 2018).</li> <li>3. Facing little support for transformative learning for sustainable development in most higher education quality assurance frameworks (Janssens, Kuppens, Mulà, Staniskiene, &amp; Zimmermann, 2022).</li> </ol>

Table 2.  
Promoting Sustainability Awareness among Graduate Economics Students.

<b>Main Objective</b>	1. Deepen the understanding of the complex interactions between socioeconomic factors, climate change, environmental policies, and renewable energy adoption to inform sustainable and equitable decision-making in the field of economics.
Educational Strategies (ES)	Related Actions (RA)
<p><b>Curriculum - Learning Topics</b> (Cassar, 2022; Eizaguirre et al., 2019; Lengyel et al., 2019; Novo-Corti et al., 2018)</p> <p><b>ES1. Sustainability Economics theory</b></p> <ul style="list-style-type: none"> <li>• Growth and sustainable development</li> <li>• Economics, biodiversity loss, and ecosystem degradation</li> <li>• Externalities of economic policies on the environment</li> <li>• Economic effects of moving to a circular economy model</li> <li>• Land-use and natural resource management</li> <li>• Economic impact of renewable energy adoption</li> <li>• Green technologies and sustainable growth</li> <li>• Sustainable transportation and urban mobility solutions</li> <li>• Sustainable tourism practices on local economies</li> <li>• Sustainable consumption patterns</li> <li>• Sustainable business practices</li> <li>• Economic models related to climate change</li> </ul>	<p><b>RA1.</b> Host climate change-related <b>conferences, seminars, and workshops</b> on policy analysis and renewable energy policy and economics (e.g., Leal et al., 2024; Mititelu et al., 2017).</p> <p><b>RA2.</b> Collaborate with <b>environmental organizations and energy companies</b> for real-world data collection and analysis (e.g., Barnes &amp; Phillips, 2000; Susilo, 2022).</p> <p><b>RA3.</b> Partner with <b>Non-Governmental Organizations (NGO)</b> and <b>Community-based Organizations (CBO)</b> to conduct environmental research, focusing on the relationship between inequality and sustainability (e.g., Kenney, Dukes, Lips, &amp; Hellmann, 2016; Susilo, 2022).</p>

<p><b>ES2. (Offering) interdisciplinary courses on sustainability</b></p> <ul style="list-style-type: none"> <li>• Sustainable Development</li> <li>• Sustainable Cities and Sustainability</li> <li>• Environmental Conservation and Ecosystem Services</li> <li>• Climate Change Policy and Governance</li> <li>• Sustainable Business Practices</li> <li>• Sustainable Energy Solutions</li> <li>• Sustainable Tourism and Ecotourism</li> <li>• Sustainable Agriculture and Food Systems</li> <li>• Biodiversity</li> <li>• Circular Economy and Waste Management</li> <li>• Consumerism</li> <li>• Environmental Ethics</li> </ul> <p><b>Educational approaches</b></p> <p><b>ES3. Emphasizing data-driven approaches to understand and address sustainability challenges</b> (Peças et al., 2023)</p> <ul style="list-style-type: none"> <li>• Analyzing data on the impact of capitalist production and consumption on sustainable development (Bătușaru &amp; Rădoiu, 2022);</li> <li>• Focusing on data analysis and evidence-based approaches to inform decision-making and policy development in the context of sustainability (Brown, Schildkamp, &amp; Hubers, 2017; Lozano et al., 2017);</li> <li>• Conducting simulation exercises to assess policy effectiveness (Hallinger, Wang, Chatpinyakoo, Nguyen, &amp; Nguyen, 2020; Yeung, So, Cheng, Cheung, &amp; Chow, 2017);</li> </ul>	<p><b>RA4.</b> Engage in <b>community outreach programs</b> to promote environmental awareness and sustainability (e.g., Lozano et al., 2017).</p> <p><b>RA5.</b> Promote <b>networking initiatives</b> in sustainability-oriented higher education to enhance students' involvement in policy debates and professional development, helping them build a strong foundation in Sustainability Economics (Dlouhá, Henderson, Kapitulčinová, &amp; Mader, 2018).</p> <p><b>RA6.</b> Encourage students to collaborate with experts on <b>research projects</b>, giving them firsthand experience working with professionals and gaining insights from their expertise (Leal et al., 2024).</p> <p><b>RA7.</b> Foster interdisciplinary collaboration through <b>multidisciplinary team projects</b> to address sustainability challenges, encouraging diverse perspectives and holistic problem-solving (Meyer, Mader, Zimmermann, &amp; Çabiri, 2017; Sundermann &amp; Fischer, 2019).</p> <p><b>RA8.</b> Offer <b>study abroad programs</b> focused on sustainability to provide a global perspective on sustainability challenges and solutions.</p>
<p><b>Expected Results</b></p> <ol style="list-style-type: none"> <li>1. Comprehension of Sustainability Economics and renewable energy economics, including the economic impacts of climate change [<b>ES1-2; RA8</b>]</li> <li>2. Expertise in formulating and assessing economic policies for equitable development and environmental conservation [<b>ES3; RA1-7</b>].</li> <li>3. Enhanced skills in policy analysis and evaluation with a focus on sustainability and climate change mitigation [<b>ES3; RA1-7</b>].</li> </ol>	<p><b>Challenges</b></p> <ol style="list-style-type: none"> <li>1. Addressing data limitations and integrating complex climate models into economic analysis (Bretschger, 2014).</li> <li>2. Addressing students' perceptions of economic goals vs. long-term sustainability objectives (Müller, 2018; Sternäng &amp; Lundholm, 2012).</li> <li>3. Fostering interdisciplinary cooperation in sustainability research and staying updated on rapidly evolving renewable energy technologies (Sharma, Steward, Ong &amp; Miguez, 2017).</li> <li>4. Overcoming policy resistance to the implementation of sustainable practices (Duarte et al., 2023; Farinha, Caeiro &amp; Azeiteiro, 2020).</li> </ol>



## 6. DISCUSSION

Tables 1 and 2 present an overview of educational approaches aimed at integrating Sustainability Economics into both undergraduate and graduate levels.

Table 1 addresses educational approaches to promote sustainability awareness in undergraduate Economics students, with the main objective of enabling them to understand and critically examine sustainable economic problems and comprehend the significance of sustainability in practical contexts so as to foster change. To begin with, it is recommended to incorporate mandatory Sustainability Economics subjects into the curriculum focused on sustainable development, Environmental Economics, and consumer and business practices (ES1). The pedagogical emphasis on introductory concepts that are the basis for theories in Sustainability Economics motivates the selection of these major topics. At this level, students are introduced to fundamental problems and economic-related principles and theories – e.g., resource depletion and circular economy models, negative externalities and renewable energy sources, corporate social responsibility, and sustainable supply chains – serving as a preparatory basis for more advanced studies and instilling a sense of global citizenship. Note that in this regard, Gomes, Jorge, and Eugénio (2021) found that there is already some concern about addressing sustainable development in Business Sciences in Portugal, as it is covered in Accounting and Taxation, as well as Management and Business Administration degrees and courses. However, their analysis reveals that only 95 degrees (48.5%) integrate related content into their curricula, with a mere 79 mandatory curricular units devoted to these subjects.

The integration of problem-based learning, experiential opportunities, and inquiry- and active-based learning approaches at the undergraduate level in Sustainability Economics education (ES2-ES4) is in line with the literature and attempts to bridge theory with real-world scenarios. These pedagogical approaches contribute to the development of practical skills, such as critical thinking and problem-solving, and actively engage students in the learning process, fostering a transformative mindset.

The related actions outlined (RA), including inviting specialists in sustainability for guest lectures and panel discussions, and organizing interactive workshops, facilitate direct engagement with professionals, fostering the exchange of information. Similarly, roundtable discussions and networking events aid students in engaging with diverse perspectives, contributing to a comprehensive understanding of sustainability issues. Anticipated outcomes include heightened awareness, improved critical thinking, and a deeper sense of ownership through community-based projects, as students are expected to experience increased awareness and understanding of sustainability issues. Additionally, engagement in problem-based learning approaches is anticipated to enhance critical thinking and problem-solving skills, providing students with real-world exposure to sustainable practices, broadening their perspective on sustainability challenges and enhancing their skills to propose evidence-based solutions.

However, it is crucial to acknowledge two significant challenges, namely, engaging undergraduate students in practical sustainability initiatives and their role in achieving a balance between economic growth and environmental protection. The challenge of engaging undergraduates is not a reflection of their lack of interest but rather lies in providing students with tangible experiences that align with their theoretical understanding. Simultaneously, the persistent challenge of balancing economic growth with environmental protection demands continuous academic attention. According to Sternäng & Lundholm (2012) students focus exclusively on economic growth and social welfare and seem to believe that environmental problems are inevitable, and that there is no dilemma between economic development and

environmental protection. Such wrong perception needs to be countered. Initiating discussions at the undergraduate level is deemed fundamental to cultivate a mindset that recognizes the intricate relationship between economic growth and environmental sustainability, strengthening a knowledge-based sense of responsibility and awareness from this level of education.

The educational approaches outlined in Table 2 aim to empower graduate economics students with advanced knowledge and skills essential for making informed decisions in areas related to Sustainability Economics. The proposals are comprehensive, covering academic study of the intricate connections between the economy and sustainability, interdisciplinary courses on sustainability, and a focus on data-driven approaches to tackle sustainability challenges

A diverse array of subjects is recommended (ES1), encompassing the adoption of renewable energy sources, the economic implications of biodiversity loss, the transition to a circular economy, and sustainable land-use practices. These topics were selected based on their contemporary relevance and global impact. They address urgent challenges, reflect the interconnectedness of economic activities with environmental and social dimensions, align with emerging trends, and hold strategic policy relevance. The adoption of renewable energy sources aligns with the need to transition towards environmentally friendly energy systems, addressing both economic and environmental concerns. Economic implications of biodiversity loss relate to a strategic need for conservation policies. The transition to a circular economy is crucial for resource efficiency and waste reduction, directly impacting economic sustainability. And finally, sustainable land-use practices are crucial for balancing economic development with environmental preservation. As Gadotti (2010, p.207) pointed out, "at the university level, besides diffusing environmental information, we need to produce new knowledge and to conduct research that aims at looking for a new development paradigm." Together, these subjects are expected to form a comprehensive and forward-looking graduate curriculum in Sustainability Economics, today. Nonetheless, while recognizing their importance, the dynamic nature of Sustainability Economics demands ongoing consideration of emerging issues and global needs to keep graduate programs at the forefront of sustainability discourse.

The comprehensive approach to sustainability education is also demonstrated by the inclusion of related interdisciplinary courses (ES2) and data-driven methodologies (ES3). Related actions (RA) include hosting climate change events to foster critical analysis, collaborating on real-world data to merge theory with application, partnering with Non-Governmental Organizations and Community-Based Organizations to link environmental issues with societal impact, networking, and multidisciplinary activities. These actions aim to bridge academic knowledge with practical relevance, emphasizing the commitment to practical fieldwork and research and the importance of connecting academia with community needs.

Major challenges include addressing data limitations and integrating complex climate models into economic analysis, demanding meticulous consideration to ensure the reliability of outcomes. Another significant hurdle is addressing students' perceptions of economic short-term goals vis-à-vis long-term sustainability, which explains the difficulty of aligning economic priorities with environmental sustainability. Moreover, fostering interdisciplinary cooperation in sustainability research is challenging, particularly given the rapid evolution of renewable energy technologies. Despite these challenges, the proposed broad and interdisciplinary approach is expected to equip graduate students in Economics (and other related courses) with the knowledge and effective communication and collaboration competencies to address critical sustainability issues.

Note that the objectives of multidisciplinary education approaches to Sustainability Economics can significantly benefit from the use of data-driven methodologies and information technology, including digital technologies, internet platforms, and data analytics. This is particularly true when attempting to expedite simulations and enable access to settings in different parts of the world, as well as data that would otherwise be unattainable. Equally relevant are soft skills, such as critical thinking, communication competencies, and problem-solving capabilities, since they enhance students' capacity to think ethically about economic choices and understand their consequences for society and the environment. This comprehensive educational approach, blending technological advancements with essential soft skills, promotes a well-rounded preparation of graduate economics students, equipping them to address the challenges of sustainability issues in the contemporary world.

## 7. CONCLUSION

This chapter looked at different ways to consolidate Sustainability Economics in the curricula of undergraduate and graduate economic-related education levels so as to enhance the knowledge and analytical skills they need to successfully address the urgent challenges posed by sustainability-related issues. The suggested educational approaches included integrating specific sustainability contents into the curriculum, using problem-based learning approaches, providing experiential opportunities, and facilitating active engagement with experts from different fields. The aim of these approaches was to promote an educational environment that encourages the formation of knowledgeable students who are capable of actively promoting sustainability.

When devising the educational proposals, it was considered their expected effectiveness and long-lasting influence within the realm of Sustainability Economics and sustainability as a whole. This was especially true when considering the complex relationship between economic growth and environmental preservation, as well as the inherent difficulties associated with implementing sustainability practices. Accordingly, the multifaceted proposals aimed to help prepare students with the knowledge and skills deemed essential for an informed balancing of immediate economic priorities with long-term environmental sustainability goals, despite the inherent challenges associated with such endeavors.

At the undergraduate level, a comprehensive and interactive approach to sustainability education was proposed, focusing on foundational concepts, practical skill development, and engagement with real-world scenarios. Two significant challenges were identified - engaging undergraduate students in practical sustainability initiatives and defining their role in achieving a balance between economic growth and environmental protection. In spite of these challenges, the importance of early discussions on the complex relationship between economic growth and environmental sustainability was acknowledged, as was the need to provide undergraduate students with tangible experiences aligned with their theoretical understanding.

At the graduate level, the goal was to equip students with advanced knowledge and skills in economic sustainability. The curriculum aimed to incorporate diverse topics such as renewable energy, biodiversity loss, the circular economy, and sustainable land-use practices, emphasizing the interconnectedness of economic activities with environmental and social dimensions. Despite acknowledged challenges, educational proposals involved enhancing interdisciplinary approaches, adopting data-driven methodologies, and engaging students in practical actions. The proposals acknowledged the dynamic nature of Sustainability Economics, emphasizing ongoing consideration of emerging issues to ensure relevance in the ever-evolving field.

Finally, the text emphasized the importance of integrating technology and data analytics into modern Sustainability Economics education, particularly highlighting their potential in processing and analyzing large datasets. Simultaneously, emphasis was placed on soft skills such as critical thinking, efficient communication, and proficient problem-solving, which empower students to critically analyze the implications of their economic decisions and the far-reaching consequences of their choices on society and the environment. Given these considerations, the effort to consolidate Sustainability Economics into academic curricula appears to be a relevant educational endeavor with the potential to influence how individuals make economic decisions in the future, thereby promoting a sustainable and equitable society.

## 8. FUTURE RESEARCH DIRECTIONS

Future research relevant to this study could consider relating these educational proposals to the United Nations' Sustainable Development Goals. Another research direction could examine how to develop dynamic, employability-focused, and practical Sustainability Economics curricula that stay in line with changing student requirements, the needs of the labor market, and sustainability concerns.

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