

THE CONTRIBUTION OF SCIENTIFIC RESEARCH TO THE PROMOTION OF ECO-INNOVATION AND GREEN ENTREPRENEURSHIP

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Abstract:

The role of scientific research in promoting green entrepreneurship, also called eco-entrepreneurship, can be approached through a cross-cutting approach involving research, entrepreneurship and environmental influences, placing scientific research in a sustainable development logic.

The university, through these two segments, namely research and teaching, constitutes the cornerstone of the dissemination of environmental culture on the one hand, and of the treatment of ecological problems within laboratories. This exercise will allow these issues to be submitted to the epistemology and methodology of university research; the objective is to achieve convincing results and eco-innovations that will be valued by the impetus of eco-entrepreneurship, driven by green start-ups.

Keywords : Scientific research, eco-entrepreneurship, eco-innovation, sustainable development, University.

JEL Classification Codes: Q1, Q5, O3

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1- Introduction:

Located at the nexus of the economic, social, and environmental pillars of sustainable development, the university plays a dual role in advancing sustainability objectives: through pedagogy, by equipping students with the skills and mindsets required for sustainability-oriented professions, and through research, by generating knowledge that addresses pressing global challenges such as climate change, greenhouse gas mitigation, renewable energy, and quality of life. This study focuses on the latter dimension, emphasizing the transformative potential of scientific research.

Placing scientific research at the service of sustainable development goes beyond merely studying relevant issues; it also entails valorizing the outcomes of such research. The form of valorization of interest in this study is the entrepreneurial dissemination of research findings and innovative ideas, through the creation of green enterprises and start-ups dedicated to various niches of sustainable development.

The relationship between entrepreneurship and sustainable development has been widely investigated. Cabanes & Denis-Rémis, (2023), in a study conducted in emerging economies, assert that entrepreneurship positively influences sustainable development and emphasize that innovation is a key factor enabling firms to achieve the Sustainable Development Goals (SDGs). These authors further highlight the crucial role of education in disseminating a sustainability mindset, within the framework of a circular economy that promotes both regenerative practices and value creation.

Moreover, the circular economy (CE) has emerged as a promising framework to address the unsustainable nature of the traditional linear food system. Unlike the “take-make-dispose” model, CE principles advocate a regenerative approach centered on waste elimination, resource recirculation, and value creation (Geissdoerfer et al., 2017).

Through this article, we aim to address the following question: What is the role of the university in disseminating and promoting innovative ideas that support green entrepreneurship, through its second mission, namely, scientific research?

The methodology underpinning this article is theoretical in nature and is based on a conceptual analysis aimed at examining, structuring, and deepening existing knowledge on the role of scientific research in the dissemination and promotion of innovative ideas conducive to green entrepreneurship. Our approach draws on a review of academic literature related to the core concepts of our study, namely eco-innovation, green entrepreneurship, and scientific research.

This methodology also involves comparing and integrating the main existing conceptual models to identify their convergences, divergences, and limitations, with the aim of proposing a coherent conceptual framework that explains the contribution of universities to the development of green entrepreneurship. This analytical and integrative approach allows for a comprehensive understanding of the subject.

2- Scientific Research in the Service of Sustainable Development: What Role in Promoting Eco-Entrepreneurship?

Anchored in its epistemological and methodological foundations, scientific research inherently adopts multidisciplinary approaches aimed at understanding and addressing complex phenomena. From this perspective, scientific inquiry can be regarded as a *moderating agent* in the pursuit of sustainable development. It simultaneously fulfills two essential functions: first, by subjecting sustainability-related challenges to systematic scientific investigation in order to identify effective and evidence-based solutions; and second, by fostering the integration of diverse disciplinary perspectives to generate holistic and sustainable outcomes.

According to Valenduc, et al., (1996, pp. 15-16), the alignment of scientific research with the objectives of sustainable development encompasses three core dimensions:

- The ecological dimension, which focuses on advancing knowledge of ecosystems, natural environments, natural resources, waste management, and environmental quality.
- The dimension of solidarity and justice, which seeks to reduce inequalities and promote equitable access to essential services and opportunities.

- The dimension of production and consumption patterns, which raises critical issues concerning economic and social growth, as well as the equitable provision of infrastructure. This latter aspect also highlights the significance of continuous research, education, and technological development as key enablers of sustainability.

Before addressing the impact of scientific research on the promotion of eco-entrepreneurship, it is essential to revisit the typology of this emerging entrepreneurial paradigm. Indeed, such an effort of synthesis and categorization provides the necessary analytical framework to delineate the scope of scientific research in shaping and supporting green entrepreneurship.

To undertake this characterization, we adopt the typology developed by Taylor & Walley, (2004) which embodies a set of universally recognized differentiating factors. This analytical framework serves as a conceptual foundation for refining our reflections and identifying the domains in which scientific inquiry can most effectively contribute to the advancement of eco-entrepreneurial initiatives.

Figure N°1. Typology of Eco-Entrepreneurs



Source : (Taylor & Walley, 2004, p. 63)

his typology of entrepreneurs is derived from two core variables: the first is intrinsic, referring to the entrepreneur's orientation; the second is extrinsic, referring to the intensity of external influences. This analytical framework, developed by Taylor & Walley, (2004), led to the identification of four archetypal forms of entrepreneurs:

- The Opportunistic Innovator : characterized by a strong economic orientation and exposure to environmental influences, this type of entrepreneur strategically capitalizes on green market niches for profit.
- The Visionary Champion : influenced by external sustainability drivers and deeply committed to environmental values, this entrepreneur demonstrates a proactive engagement in environmental protection.
- The Ethical Maverick : guided by an internal ecological commitment while remaining relatively detached from external environmental pressures.

- The Accidental Entrepreneur : driven primarily by economic motivations and operating independently of any environmental imperatives.

Within this framework, scientific research emerges as a catalytic platform for fostering technological innovation conducive to sustainable development and green transformation.

Scientific research constitutes a systematic endeavor aimed at addressing complex problems, which, according to Van Der Maren, (2014), must originate from well-defined research questions. Its ultimate purpose is to analyze multifaceted phenomena and produce results that are subject to valorization within the socio-economic ecosystem.

From a systemic perspective, scientific research incorporates all external parameters that may influence both the research methodology and its underlying epistemological frameworks. It mobilizes theoretical and conceptual instruments, analytical and data-processing techniques (including advanced software tools), which interact dynamically to yield robust and actionable outcomes.

3- Eco-entrepreneurship and Eco-innovation: A Theoretical and Conceptual Framework

Integrating the concept of sustainable development into that of the firm gives rise to two main considerations. The first entails a corporate commitment to respecting both economic and environmental dimensions in the pursuit of financial and strategic objectives. The second involves the development of a business plan dedicated exclusively to sustainability. In this regard, the firm undertakes activities aligned with the achievement of the Sustainable Development Goals (SDGs). This orientation is commonly referred to as green, sustainable, or ecological entrepreneurship. Sheldon & Lüdeke-Freund (2023) propose a novel approach, namely *sustainability entrepreneurship*.

This form of entrepreneurship places sustainability at the core of business activity. According to these authors, such entrepreneurship compels firms to engage in significant social and environmental transformations. Illustrative examples include agri-food companies offering organic products or firms specializing in waste recycling.

Green entrepreneurship is closely associated with eco-entrepreneurship, which consists in creating businesses by capitalizing on ecological opportunities (Ben Hadj Youssef & Dziri, 2012). Eco-entrepreneurship thus refers to the application of managerial tools aimed at preserving and enhancing the environment.

The challenge of eco-entrepreneurship is twofold: on the one hand, it requires integrating environmental concerns into business strategy, while on the other, it demands ensuring financial profitability in an increasingly competitive landscape. This heightened competition can be partially explained by exogenous factors, particularly public policies designed to encourage economic actors to invest in sectors that foster sustainable development.

To strengthen competitive advantage and differentiate themselves from other green enterprises, firms must rely on innovation as a key success factor. Within the context of sustainability, this takes the form of eco-innovation (Horbach, Rammer, & Rennings, 2011).

According to (Steux & Aggeri, 2021), eco-innovation is considered a type of environmental innovation. In this trajectory, fostering the emergence of novel ideas targeted toward ecological and environmental segments becomes essential. Consequently, innovative start-ups are being developed to offer solutions addressing environmental shortcomings, often through business models explicitly aligned with the SDGs. In this sense, scientific research plays a pivotal role in advancing innovative ideas that can be operationalized through the creation of green start-ups.

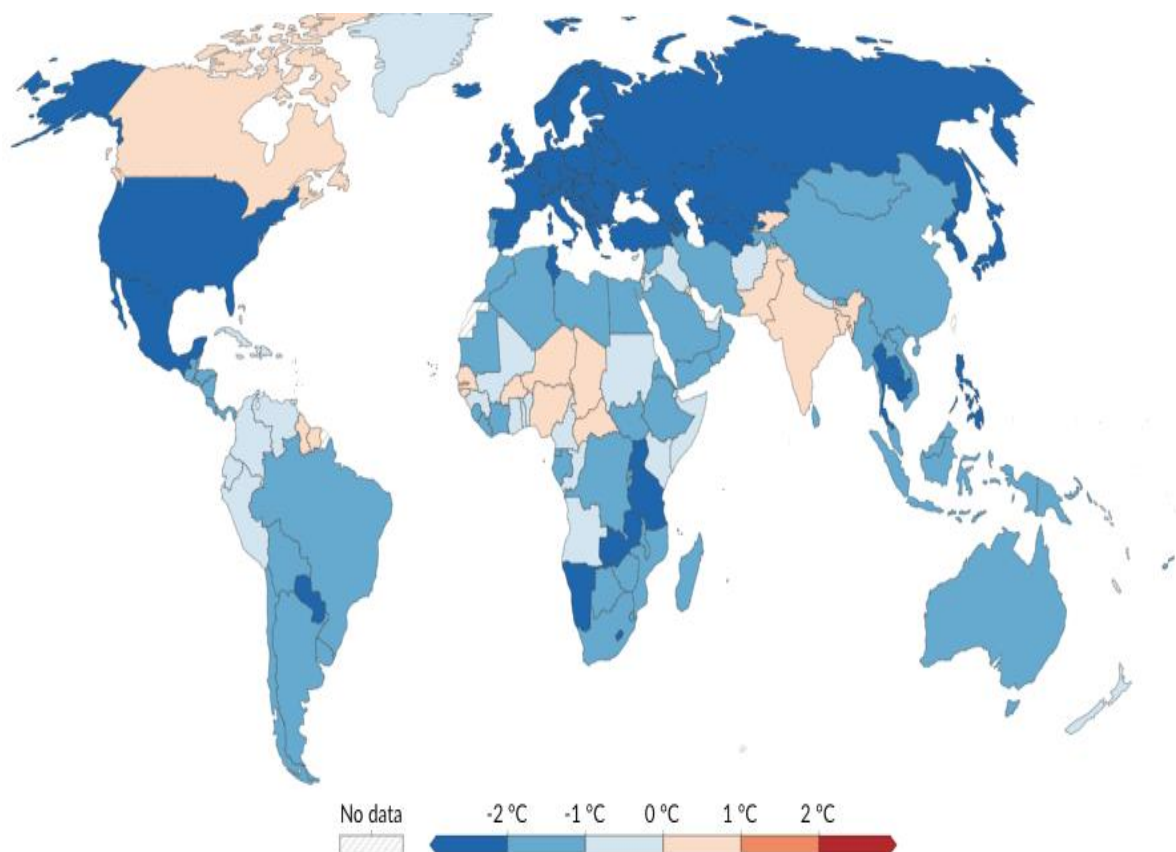
4- Context and analysis of climate change: how can the turn to green entrepreneurship be justified?

4-1. Analysis of temperature data supporting climate change

Climate change emerges as a multidimensional variable, encompassing environmental, social, economic, and geopolitical challenges, among others. Switzerland has ratified a convention aimed at redefining its borders with France and Italy; the underlying reason is none other than the retreat of glaciers.

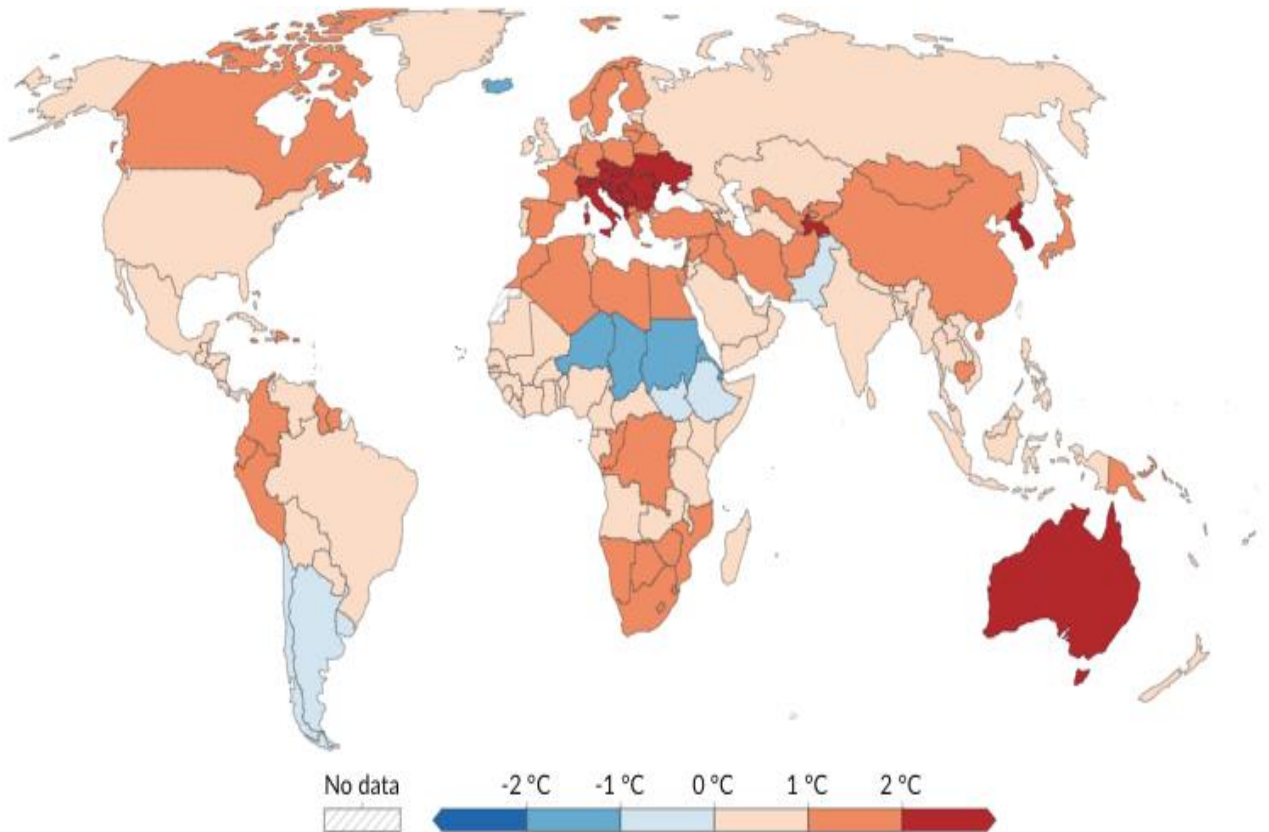
As a cyclical phenomenon, global warming manifests worldwide, although countries are affected to varying degrees, as illustrated in the two maps below:

Map N°1: Monthly Global Temperature Anomalies in 1940.



Source : <https://ourworldindata.org/grapher/monthly-temperature-anomalies?time=earliest>, consulted on 01/10/2025.

Map N° 2: Global Monthly Temperature Anomalies in 2024



Source : <https://ourworldindata.org/grapher/monthly-temperature-anomalies?time=earliest>, consulted on 01/10/2025.

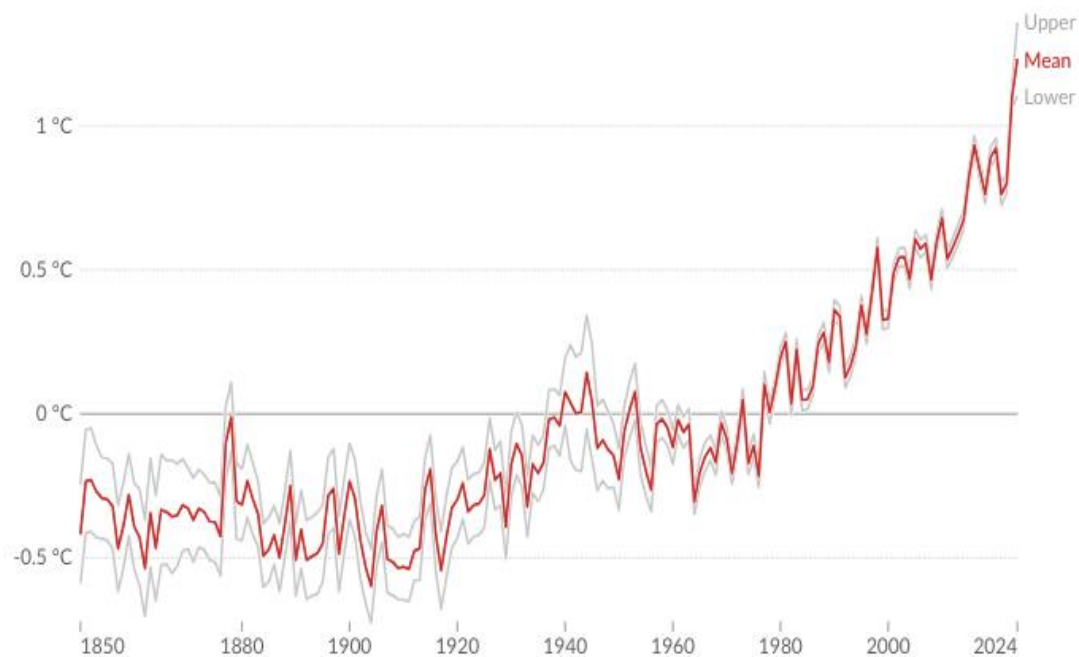
The graph below depicts the long-term evolution of global monthly temperature anomalies between 1850 and 2024. The data reveal three major climatic phases:

- 1850–1940: This initial phase exhibits relatively stable temperature conditions, with anomalies remaining close to or below the 0°C baseline, reflecting a period of limited climatic variability.
- 1940–1980: A transitional period marked by slight positive anomalies, yet with a prevailing tendency toward cooler conditions, suggesting temporary climatic stabilization.
- 1980–2000: This period signals the onset of a sustained and accelerated warming trend, with mean anomalies reaching

approximately 0.58°C by 1998, indicating the consolidation of global temperature rise.

- 2000–2024: Characterized by unprecedented warming episodes, particularly during summer months, with anomalies consistently exceeding 1°C — reaching 1.10°C in 2023 and 1.23°C in 2024 — thereby confirming the intensification of global warming in the early twenty-first century.

Graph N° 1. Evolution of Monthly Temperature Anomalies between 1850 and 2024



Source : <https://ourworldindata.org/climate-change>, consulted on 03/10/2025.

4-2. From Climate Change to the Sustainable Development Goals (SDGs)

The repercussions of temperature anomalies constitute a major turning point and form the basis of global engagement in sustainable development dynamics. Once climate disturbances triggered a debate encompassing all dimensions of economic and social life, they led to the formulation of the Millennium Development Goals (MDGs) for 2030, which were later broadened into the Sustainable Development Goals

(SDGs). These goals clearly reflect the multidimensional and interdisciplinary nature of sustainable development and the fight against climate change.

A deeper analysis of the SDGs reveals that the central challenge does not merely lie in reducing greenhouse gas emissions. Rather, it encompasses the fight against poverty and social inequalities, the promotion of technology transfer, and both technological and social innovation — all of which are essential variables for achieving sustainable and equitable economic development. These interrelated dimensions require effective institutional collaboration to ensure the attainment of the SDGs.

Achieving these goals calls for an integrated development strategy, aimed at aligning the variables originally defined within the MDGs framework. However, it is important to note the existence of a common denominator across all SDGs: green entrepreneurship, also referred to as eco-entrepreneurship.

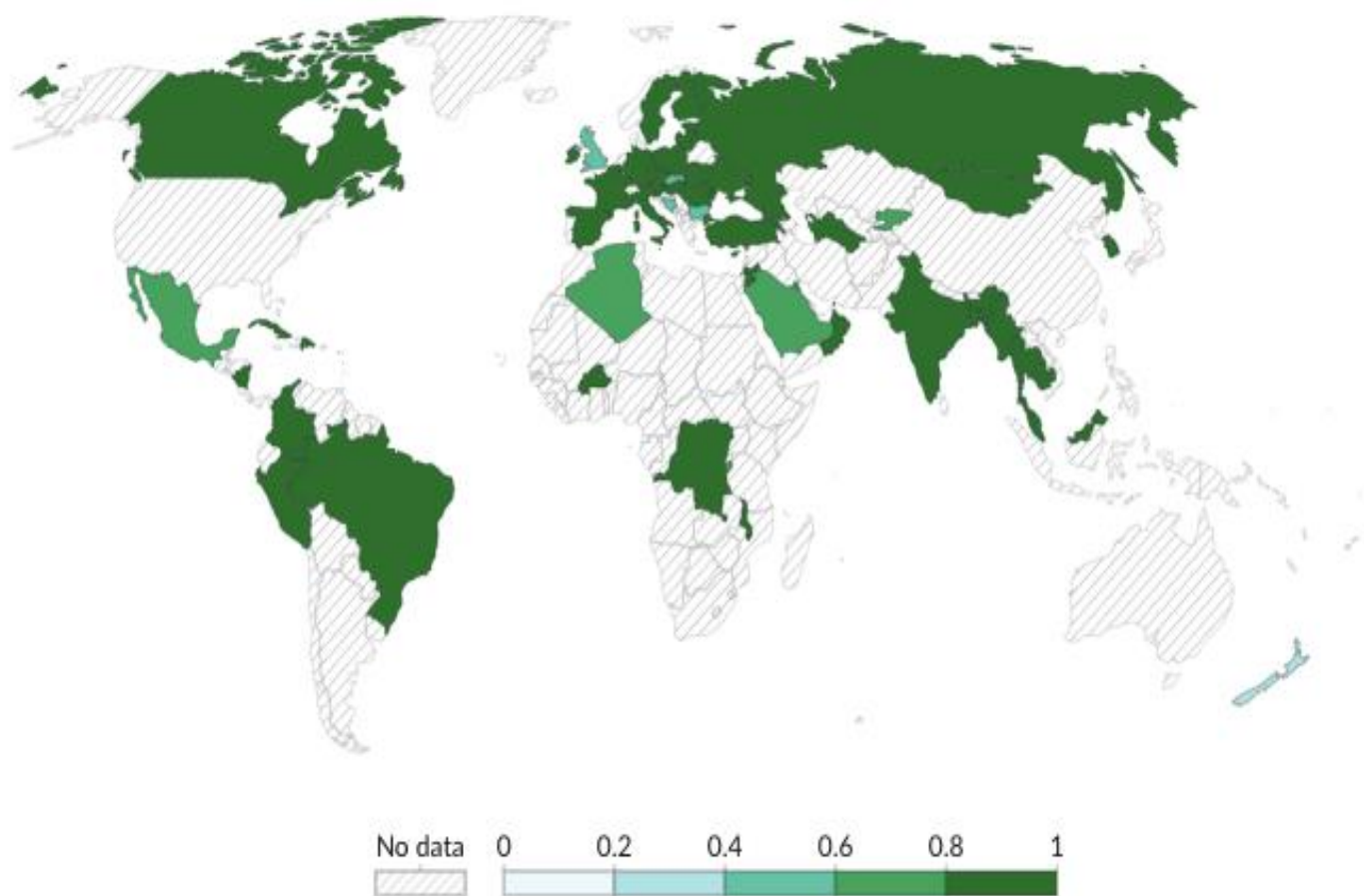
In the following section, we will focus on the role of the university in achieving the SDGs, emphasizing its contribution to fostering ecological entrepreneurial dynamics, particularly through academic action and scientific research.

5- The Role of Education and Scientific Research in Achieving the Sustainable Development Goals (SDGs)

Integrating the SDGs into education, highlights the complexity of the task. Education, by nature, is multidisciplinary; embedding it within the sustainable dimensions promoted by the SDGs necessarily requires intersectoral governance, which in some cases operates at subnational levels.

Education for sustainable development seeks to transcend a strictly sectoral approach, striving to diversify its modes of intervention and to foster the construction of knowledge that is both pluralistic and integrated. It entails a transition from a logic of multidisciplinary to a dynamic of interdisciplinarity. (Lasida & Quazzo, 2009).

Map N° 3. Integration of Global Citizenship and Sustainable Development into National Education Policies, 2020.



Source : <https://ourworldindata.org/sdgs/quality-education>, consulted on 06/10/2025.

These measures reflect the structural dynamics specific to each national education system, as reported by the respective governmental authorities. They primarily capture the strategic orientations and policy commitments of governments rather than the actual implementation of educational policies on the ground.

The data associated with this indicator are presented through interactive visualizations, enabling a comprehensive understanding of the various dimensions of educational action — particularly those related to teacher training, curriculum design, student assessment, and the formulation of

national education policies. (<https://ourworldindata.org/sdgs/quality-education>, consulted on 06/10/2025).

This indicator aims to promote a coherent and harmonized assimilation of the sustainable development paradigm, fostering the convergence of collective efforts toward the establishment of a consistent and long-term development trajectory. It represents, moreover, a necessary condition for reinforcing the systemic interconnections that underpin the triptych of sustainable development.

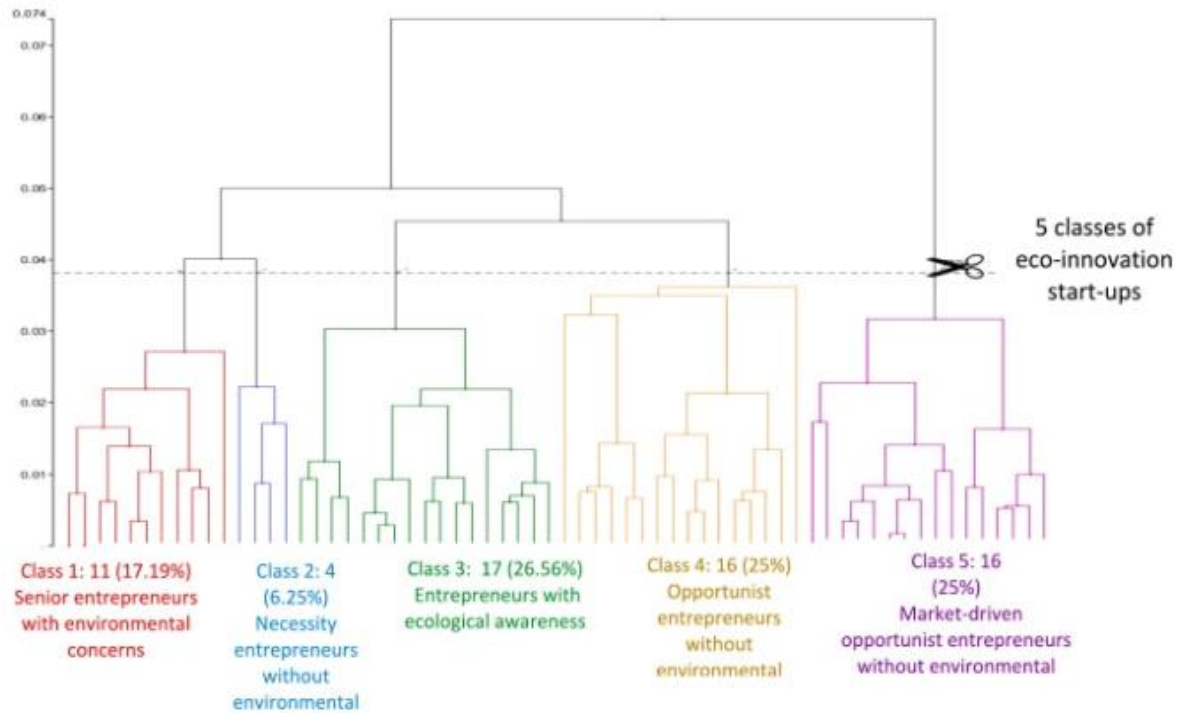
From this perspective, education emerges as a pivotal vector for sustainability. Through its multidimensional structure, it embodies both the prerequisites and the enabling conditions required to articulate and balance the three foundational pillars of sustainable development - the economic, the social, and the environmental. By fostering cross-disciplinary learning and awareness, education thus serves as a catalyst for integrating these dimensions into coherent and actionable development strategies.

6- Eco-innovation and Start-ups: The University's Driving Role through Pedagogy and Scientific Research

The findings of the present study demonstrate that the founders of eco-innovative start-ups possess specific characteristics determined by two key factors, namely environmental education and professional experience (Abdesselam, Kedjar, & Renou-Maissant, 2024).

This result highlights the pivotal role of the university through its two fundamental dimensions—pedagogy and research. The first contributes to the dissemination of environmental knowledge by embedding ecological culture among individuals, while the second enables the resolution of environmental issues across various disciplines. Indeed, this typology, similar to that proposed by Taylor & Walley (2004), is not fixed or static; on the contrary, it is dynamic and continuously evolving.

Figure 2. Typology of eco-innovative start-ups according to their entrepreneurial characteristics.



Source : (Abdesselam, Kedjar, & Renou-Maissant, 2024, p. 18)

Abdesselam, Kedjar, & Renou-Maissant, (2024), through an empirical investigation involving 64 start-ups, identified five distinct categories of eco-innovative enterprises, each reflecting a particular configuration of entrepreneurial orientation and environmental commitment:

- ✓ Class 1: Environmentally Conscious Senior Entrepreneurs, This category encompasses start-ups that implement radical environmental innovations, conceived upstream, at the very inception of the entrepreneurial idea.
- ✓ Class 2: Necessity-driven Entrepreneurs without Environmental Concerns, these start-ups do not pursue explicit environmental objectives; rather, environmental considerations appear sporadically and incidentally within their operational activities.
- ✓ Class 3: Ecologically Aware Entrepreneurs, these entities actively design environmentally oriented solutions, engaging in a collective and collaborative form of eco-innovation.

- ✓ Class 4: Market-driven Opportunistic Entrepreneurs without Environmental Commitment, these start-ups capitalize on market niches associated with environmental protection, primarily seeking commercial advantage rather than ecological impact.
- ✓ Class 5: Opportunistic Leaders, this group refers to start-ups that promote ideas with intended environmental impact, which are subjected to R&D processes to achieve operational activation. These start-ups develop internal and external eco-innovative solutions to serve industries seeking to reduce costs while embedding environmental management practices within their organizational structures.

By analyzing these categories of eco-innovative start-ups, it becomes evident that scientific research exerts a decisive influence on accelerating the innovation process, particularly in Classes 1, 4, and 5, where environmental concerns are embedded at the ideation stage, i.e., at the very launch of the start-up.

Conversely, for Classes 2 and 4, scientific research can serve as a catalytic mechanism, stimulating environmental awareness and technological adaptation.

7- Conclusion:

The university, as a crucial vector of knowledge dissemination, constitutes a bridge between individuals and sustainable development aspirations. It plays a dual pedagogical role: first, by cultivating entrepreneurial culture and training individuals in professions that safeguard the environment; second, by advancing scientific inquiry capable of addressing environmental challenges through rigorous methodological and analytical frameworks.

Through its research mission, the university simultaneously contributes to:

1. Diagnosing and resolving environmental issues by mobilizing scientific and methodological tools; and

2. Showcasing and valorizing eco-innovative ideas, fostering the creation of start-ups, green deep-tech ventures, and sustainable enterprises.

This theoretical reflection highlights the idea that scientific research is moving beyond its traditional role to engage in the production and dissemination of knowledge that supports the achievement of the Sustainable Development Goals. This shift is materialized through the design of green solutions that are subsequently valorized by enterprises operating within the ecological sector. It can therefore be concluded that scientific research is to be regarded as a strategic lever for the energy transition.

The characterization of eco-entrepreneurship thus underscores the adaptive and mediating function of scientific research. Each type of eco-entrepreneur represents a potential axis of consolidation and moderation for research aimed at devising solutions to environmental challenges.

The stakes are both ecological and economic, as they involve the creation of sustainable added value through innovation, knowledge, and environmental stewardship.

The entrepreneurial implementation of innovative environmentally-friendly ideas requires the pedagogical enhancement of scientific research outcomes; this constitutes an essential condition for imparting entrepreneurial skills conducive to the circular economy. This entails the design of training programs and workshops enabling students to acquire knowledge in sustainable project management and ecological innovation.

Scientific research, through its capacity to address concrete problems, remains an indispensable source of creativity and innovation. Companies can thus find in research key levers of differentiation, as well as tangible and intangible determinants of competitiveness. However, this logic presupposes the implementation of a multi-actor strategy aimed not only at aligning stakeholders' interests toward a common objective, but also at fostering productive interactions within a sustainable value chain.

This theoretical reflection has enabled us to identify the key determinants of the contribution of scientific research to the promotion of green innovation and entrepreneurship. As a future research direction, this

work will involve conducting an empirical study on the various mechanisms that enable the transfer of scientific research results to the business sector, as well as to the broader socio-economic environment.

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