Resilient sustainability and regeneration in higher education as a tool for transition to the new Anthropocene

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Abstract: The transition to resilient sustainability and regeneration are the human adaptation tools for the new Anthropocene, considering that it is imperative to balance economic development with care for the environment. To achieve this transition, higher education plays a key role preparing the future generations to address today's environmental and social challenges. The integration of sustainability in education is not limited to the acquisition of knowledge about environmentally friendly practices, but also involves the development of critical skills, systems thinking and global awareness. Accordingly, resilient sustainability and regeneration are an essential part of the future of education, so attaching these concepts into academic programs does not only provides the students practical tools to address current issues, but also instills values of responsibility and global citizenship. Sustainability in education can influence ethical decision-making and the adoption of sustainable practices in a variety of fields, from economics to technology.

Keywords: project management; resilient sustainability–regeneration; new Anthropocene - higher education institutions; sustainable development goals; pedagogical strategies.

Sostenibilidad resiliente y regeneración en educación superior como herramienta de transición al nuevo Antropoceno

Resumen: La transición hacia la sostenibilidad resiliente y la regeneración se configuran como las herramientas de adaptación humana para el nuevo Antropoceno, teniendo en cuenta que es imperativo equilibrar el desarrollo económico con el cuidado del entorno. Para alcanzar esta transición la educación superior desempeña un papel fundamental a fin de preparar a las generaciones futuras para abordar los desafíos ambientales y sociales actuales. La integración de la sostenibilidad en la educación no se limita a la adquisición de conocimientos sobre prácticas respetuosas con el ambiente, sino que también implica el desarrollo de habilidades críticas, pensamiento sistémico y conciencia global. En concordancia con lo anterior la sostenibilidad resiliente y la regeneración son una parte esencial del futuro de la educación, de tal forma que incorporar estos conceptos en los programas académicos no solo proporciona a los estudiantes herramientas prácticas para abordar problemas actuales, sino que también les inculca valores de responsabilidad y ciudadanía global. La sostenibilidad en la educación puede influir en la toma de decisiones éticas y en la adopción de prácticas sostenibles en diversos campos, desde la economía hasta la tecnología.

Palabras clave: gestión de proyectos; sostenibilidad resiliente-regeneración; nuevo Antropoceno; Instituciones de Educación Superior; Objetivos de Desarrollo Sostenible; estrategias pedagógicas.

Introduction

The transition to ecosystem and social regeneration is an approach that recognizes the need to change the way in which anthropogenic and business activities are managed to address the environmental and social challenges that humanity has to face today. This is essential to ensure long-term sustainability and guarantee that the ecosystems will continue to provide vital services such as clean water and air and that they can provide natural

resources for future generations. This transition not only builds business resilience by helping companies to manage more effectively the risks associated with resource scarcity, market volatility and government regulations, but also aligns with corporate social responsibility, while enhancing corporate reputation, strengthening customer relationships, and fostering innovation, which translates into long-term competitive advantage. It also facilitates compliance with the United Nations Sustainable Development Goals and enables companies to engage their employees and meet customer expectations by demonstrating a strong commitment to sustainability and social responsibility.

From the Stockholm Earth Summit in 1972 to the present day with the 2030 Sustainable Development Goals, university education has played a responsible and active role in promoting sustainable development. Higher education has become a key vehicle for achieving this goal, thanks to its commitment to training, its research capacity and its altruistic approach.

Universities have shown a growing interest in the topic of sustainability and have sought to integrate the Sustainable Development Goals (SDGs) into their curricula, although in different ways and without mandatory establishing measurable structures [1]; instead, their focus has been on fostering high awareness [2], disseminating these topics among students and being addressed in specialized courses in graduate programs [3]. Despite this, the concepts related to the transition to the new Anthropocene are still not widely known and disseminated, even though authors such as Elinor Ostrom were already expressing ideas about sustainable resource management and the relevance of cooperation and self-management to face the challenges associated with this era defined by human influence on the environment, although she did not directly use the term Anthropocene [4] [5]. Although its feasibility has been proven from social, economic, technical and ecosystemic perspectives, as we reach 2030 [6], there is no mechanism in sight to ensure the continuity of the legacy of sustainability in protecting the environment to guarantee human survival and a high quality of life in the future. Currently, the implementation of competencies to address this necessary transition to the new Anthropocene has not yet been systematically integrated into academic programs [7].

Incorporating the Sustainable Development Goals (SDGs) into the curricula of higher education institutions entails addressing complex social and environmental issues marked by interconnections and conflicts of values. This will enable students to develop skills for complex thinking, overcoming established paradigms, learning through dialogue and communication, among other things, thereby empowering them to engage in reflections and build their own perspectives and values. Therefore, the importance of directing efforts in higher education towards achieving the SDGs is emphasized, particularly focusing on goals 4, 5, and 10 in this study, which will help advance towards a fairer, more equitable society without discrimination against women [8].

This text analyzes the situation of university education in the face of the adaptation of the new Anthropocene in order to propose the incorporation of resilient sustainability and regeneration as a transversal competence in higher education academic programs. For this, it is necessary to characterize the main challenges of higher education to prepare future professionals in the knowledge of these concepts and to recognize them as adaptation mechanisms towards this transition, which requires the future professional in all areas of knowledge.

Background

In Colombia, the Global Compact and the PRME program provide a global network for academic institutions seeking to promote sustainability and corporate social responsibility. Although they do not provide an explicit guide or procedure for the implementation of the SDGs in university education [9].

Many universities in Colombia express interest in participating in advancing the goals towards the SDGs.*Universidad Nacional de Colombia*, for example, implements programs from the faculty of engineering, following the guidelines of CONPES 3918 [10]*Universidad de los Andes* operates the "Sustainable Development Goals Center (CODS in Spanish) for Latin America and Caribbean", which develops programs for the implementation of the SDGs within the University through various research and training programs such as the Master's Degree in Regeneration and Sustainable Development. [11]. *Universidad El Bosque, Universidad Católica, Universidad Antonio Nariño, Fundación Universitaria Juan N. Corpas* and *Universidad de América*, started in 2023

the "ODS Catedra: Don't leave anybody behind" dedicated to the dissemination and study of the 17 Sustainable Development Goals (SDGs) and the purpose of promoting their understanding and analysis of experiences of their application [12]. For its part, *Universidad Piloto* since 2020 obtained the qualified registration for a PhD in Sustainable Territorial Management, which promulgates the search for collective well-being through addressing the challenges in the territories [13]. In turn, *Universidad Ean*, in addition to multiple courses and diploma courses related to sustainability and regeneration, offers a master's degree in Sustainable Development Projects that seeks to promote the growth of sustainable communities. Furthermore, Ean University favors training in the development of sustainable thinking, where students are able to lead innovation processes to move towards sustainability (both individual and collective) from the understanding of elements from science and social knowledge to influence decision-making that generate positive impacts on society, the economy and the environment.

The university as an autonomous learning community whose main functions are to generate a universal orientation across disciplines and cultures, to facilitate the holistic development of its members, to create new holistic understandings of planetary challenges, including transdisciplinary research co-designed and engaged with stakeholders, oriented towards solutions, to develop responsible professionals, to enhance society's problem-solving capacities, and to catalyze progressive changes in human-earth systems [14].

In spite of the above, these efforts are considered insufficient, taking into account that this knowledge and ability should be considered as a transversal knowledge, which allows the adaptation of economic and productive systems for the future, and none of the universities offer study units that prepare future professionals for a complex and uncertain future, with a necessary change of raw materials, differential energy systems, and strengthened environmental and social protection legislation.

Updating of concepts and their application in the university context.

Sustainability in general has enjoyed a subjectivity in the implementation and the impossibility of measuring the scope of the competencies required for the future professional or graduate, the perhaps most constant guideline is the implementation of the SDGs in the development of Society. However, neither has it been developed in a timely, measurable or concrete manner [15]. On the other hand, resilient sustainability, which allows the company and society to adapt to change and recover even in the face of changing conditions through regeneration, are not yet widespread concepts in the social, academic or business community.

Currently, resilient sustainability and regeneration are projected as tools that allow us to rethink the human position in the new Anthropocene, incorporating strategies that allow economic development to be compatible with social and environmental development, understanding that negative impacts on the eco-environments have repercussions on productive and economic systems and, of course, on the quality of life of humans.

To achieve this, knowledge of planetary boundaries is essential in the context of ecosystem and social regeneration, as it provides clear guidance for maintaining a sustainable balance between human activities and the health of the planet. These boundaries represent critical thresholds in the global Earth system that, if crossed, can trigger irreversible environmental changes. The importance of understanding these limits lies in their ability to guide regeneration strategies towards sustainability, defining the ecological limits that should not be crossed, thus preventing the occurrence of irreversible damage to the environment. Together with the above, they make it possible to preserve biodiversity and the integrity of ecosystems, fundamental for any regeneration effort by promoting the resilience of ecosystems and allowing their recovery and strengthening over time, while redefining business practices to ensure that they do not cause ecological damage, driving innovation and sustainability. In this process it is also essential to educate and raise public awareness of the importance of sustainability and regeneration, mobilizing individuals, companies and governments towards responsible actions. Through this route it would then be possible to achieve the Sustainable Development Goals (SDGs) of the United Nations [16].

In addition to the previously mentioned strategies, it´s observed that more and more higher education institutions worldwide are making important modifications in their curricula to cover the necessary areas of knowledge and meet the current challenges in terms of sustainable development, some examples are mentioned below: The work done by Perpignan [17] on the perspectives of higher education in engineering for sustainable development, shows the importance of working in engineering programs concepts and tools of eco-design, choice of materials or energy, use of life cycle analysis tools, to evaluate the environmental performance of products and propose solutions with less environmental impact. In addition, this work highlights the importance that training should include interdisciplinary skills. In the same sense and as mentioned by Ashford [18], the growing universal concern for promoting a more sustainable development presents considerable challenges for both education and research. The disciplines commonly established at the base of science and engineering undoubtedly continue to provide useful advances, but it is necessary to work even more on integrated systems thinking (in government, business and educational institutions) to achieve visible and high impact achievements to global development goals. An interesting research contributing to the role of engineers in achieving the Sustainable Development Goals (SDGs), conducted by Beagon [19] et at., where key stakeholders in engineering education (academics, employers and students) were examined and compared using twelve focus groups in Denmark, Finland, France and Ireland, evidenced a strong emphasis on normative, strategic and systems thinking competencies in engineering. Key competencies such as communication, teamwork and decision making in complex systems are also highlighted.

Methodology

The type of research is qualitative, exploratory [20]. The methodology starts with an analysis through convenience sampling by the researchers, with the target population being public and private universities in the country. The sample consists of 13 universities, 5 public and 9 private. The selected universities are: Universidad Nacional de Colombia, Universidad de Antioquia, Universidad del Valle, Universidad Pedagógica Nacional, Universidad Industrial de Santander (UIS), Universidad de Cartagena, Universidad de Caldas, Universidad Tecnológica de Pereira (UTP), Universidad de los Andes, Pontificia Universidad Javeriana, Universidad del Rosario, Universidad EAFIT, Universidad Externado de Colombia, Universidad de La Sabana, Universidad ICESI, Universidad del Norte, Universidad Santo Tomás, Universidad Autónoma de Bucaramanga (UNAB), Universidad Pontificia Bolivariana (UPB), Universidad de La Salle, Universidad del Sinú, Universidad de San Buenaventura, Universidad EAN, Universidad CES. The methodology applied in this work comprises two phases, as described in the following sections.

Phase 1: Recognition of the state of the universities in terms of preparing future professionals for the new Anthropocene. The evaluation tool used was a semi-structured interview conducted with 10 members of the university community from each of the aforementioned universities, selected at random.

The evaluation tool consists of:

Introduction and General Context
1. Could you briefly describe your role and responsibilities within the university? 2. How does your university define resilient sustainability and regeneration?

Institutional Policies and Strategies
3. What policies and strategies has your university implemented to promote resilient sustainability and regeneration? 4. How are these policies integrated into the university's mission and vision?

Academic programs and Curriculum
5. How have concepts of resilient sustainability and regeneration been incorporated into academic programs? 6. Could you provide examples of specific courses or projects addressing these topics?

Development of skills and values
7. How does the university promote the development of students' critical skills, systemic thinking and global awareness? 8. What strategies does the university use to instil values of responsibility and global citizenship?

Research and projects
9. Are there any research projects at your institution that focus on resilient sustainability and regeneration? 10. How are students involved in these projects?

Challenges and opportunities
11. What have been the main challenges in the transition to resilient sustainability and regeneration at your university? 12. What opportunities has your university identified in this process?

Impact and evaluation
13. How does your institution measure the impact of its resilient sustainability and regeneration initiatives? 14. What outcomes and benefits have been observed so far?

Future and continuous improvement
15. What are the next steps to advance resilient sustainability and regeneration at your campus? 16. What recommendations would you make to other institutions wishing to integrate these concepts?

Phase 2: Methodological proposal

The construction of the methodological proposal was based on recommendations received from universities that have implemented specific processes on the topic, mainly Universidad EAN and Universidad de Antioquia. In addition, information on relevant training was gathered from the Scopus database and the Scrum methodology was applied. A didactic methodology for the improvement of sustainable development competencies in higher education training programs was considered [21].

Results

The following is a proposed methodology for the incorporation of resilient sustainability and regeneration competencies as tools to prepare new professionals for the new Anthropocene.

- Challenge 1: Competence in resilient sustainability and regeneration

According to Gil [11], the main challenge is the conceptual appropriation of the members of the institution, including the faculty, on the topic of resilient sustainability and adaptation to the new Anthropocene, which should not only be a knowledge of experts but of all human beings.

Proposal: Options for competency development to enable conceptualization include self-managed learning, group discussions and training.

- Challenge 2: Revision of programs and contents and inclusion of the concepts of the new Anthropocene and transition to resilient sustainability.

Proposal: Define a route for each academic program manager to analyze the relationship between competencies and disciplinary topics and their relationship with the challenges of the new Anthropocene.

- Challenge 3: To ensure that students develop competence for a future in which they will face a world with different systems of communication, production, transportation, among others, in their professional development.

Proposal: Design of teaching-learning strategies and indicators to evaluate the fulfillment of achievements according to each academic cycle in the incorporation and appropriation of the concepts of how to think the new Anthropocene, its needs, possible geopolitical, economic, social, productive changes, among others. Within the programs.

- Challenge 4: Permeability of society through extension and research, integrating the transition to resilient sustainability and regeneration as a mechanism of transition to the new Anthropocene.

Proposal: Verification of research articles - degree works - Resilient sustainability and regeneration of research - extension - virtual courses - electives open to society to ensure understanding and adaptation to this transition in global issues.

Learning Strategies and Resources

Once the dynamics of each program have been defined, the strategy to be used to address each competency is chosen. Table 1 proposes various strategies, techniques or instruments.

Table 1. Strategies and techniques for each moment

Moment	Strategy, technique or instrument
To know	IPLER reading SQA Scheme Virtual learning objects Timeline Videos
To Analyze	Graphic Schemes Concept maps Essays Forums
To apply and evaluate	Essays Resilient and regenerative classroom Portfolios Case solution Problem-based learning

Source: The authors

Process route for the incorporation for the preparation of future professionals for resilient sustainability and regeneration.

The proposed route for incorporation, based on the above elements and considering general criteria for action to minimize the subjectivity of their integration into a disciplinary core or an academic program, comprises the following stages:

- Develop the conceptualization of New Anthropocene, resilient sustainability and regeneration.

- Analyze the purpose and structure of each concept.

- Understand the role of your professional program in the New Anthropocene.

- Associate resilient sustainability and regeneration to the disciplinary core to the graduate competencies or Outcomes and in the micro-curricula.

- Select the strategy, technique or instrument to develop understanding, analysis and application.

- Define the instrument to evaluate the appropriation of the elements of the goal(s) in the academic disciplinary core and program.

Conclusions

By analyzing the main theoretical and conceptual references of the needs of the new Anthropocene and identifying resilient sustainability and regeneration as a fundamental element to face the transition to the future, it became evident that, in general, models and guidelines have been developed for the implementation of the SDGs in universities, but no preparations have been made for the changes after 2030; which consist of processes from diagnosis, the commitment of universities, implementation in academic programs, the creation of indicators and the scaling of these processes towards society.

On the other hand, higher education in resilient sustainability promotes gender equality by allowing women anywhere in the interconnected world to access quality higher education, developing their skills and competencies.

Finally, a guide is proposed for the inclusion of the academic programs of the Sustainable Development Goals in virtual methodology for higher education, which consists of identifying the (Three moments of the implementation of the SDGs in the Academic programs) these three moments are: The first moment is related to Knowing the SDGs through IPLER Readings, SQA Schemes, OVA(Virtual Learning Object), Timelines, videos; it is suggested that such moment is carried out in the initial knowledge levels of the academic program. The second moment: Analyze the SDGs, where it is suggested as a strategy to use graphic schemes, concept maps, essays and forums as tools. Likewise, it is suggested to implement this moment in the middle level of the academic program.

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