Tuning América Latina

With the support of the Erasmus+ Programme of the European Union

Qualifications Reference Framework for programmes in the Subject Area of Environmental Studies in South America

This section provides a detailed explanation of the dimensions and sub-dimensions that make up the meta-profile or regional framework of reference for training in the environmental field. In the process of construction of the meta-profile of the Environmental area, it was considered that there is no single disciplinary area since the training approach is transdisciplinary. The 7 emerging dimensions are articulated through sub-dimensions, which are described in the following Table:

Table 1: Dimensions and sub-dimensions for the training of an environmental professional

DIMENSION	SUB DIMENSION
1. LEARNING AND KNOWLEDGE MANAGEMENT	1. Basic Sciences
	1.2 Natural Sciences
	1.3 Applied environmental science
	1.4 Sciences applied to Environmental Engineering
	1.5 Sustainable Production Processes
	1.6 Economy and Environment
2. CONTEXTUALIZED SOLUTION OF ENVIRONMENTAL PROBLEMS	2.1 Problem identification and management
	2.2 Analysis and understanding of chemical, physical and/or biological phenomena.
	2.3 Application of mathematics, science, and environmental engineering concepts
	2.4 Project Management
	2.5 Comprehensive Risk Analysis
	2.6 Prevention, Mitigation, Compensation of socio-environmental impacts
	2.7 Project Development
	2.8 Sustainable Energy Development and Application

	2.9 Management of environmental issues
	2.10 Environmental sanitation and services
	2.11 Utilisation and Quality of Hydric Resources
	2.12 Science, Technology and Society
3. RESEARCH AND DEVELOPMENT	3.1 Data collection and analysis
	3.2 Development of mathematical models
	3.3 Innovation
	3.4 Applied research from Environmental Impact Assessment
	3.5 Research projects development and execution
	3.6 Dissemination of scientific and technological knowledge
4. DESIGN AND TECHNOLOGIES APPLIED TO THE ENVIRONMENT	4.1 Development and application of technologies for the comprehensive management of natural resources.
	4.2 Application of technologies for mitigation and adaptation to climate change.
	4.3 Disaster risk analysis
	4.4 Sustainable energy management, design and implementation of renewable energies.
	4.5 Design of waste treatment and management systems
	4.6 Sustainable Production Design
5. ASSERTIVE COMMUNICATION AND COLLABORATIVE WORK	5.1 Assertive Communication
	5.2 Pro-active Communication Management
	5.3 Collaborative and Teamwork
6. INFORMATION TECHNOLOGY MANAGEMENT	6.1 Data mining: Search, generation and systematisation of information.
	6.2 Real-time data system, collection and storage
	6.3 Implementation of Geospatial technologies
	6.4 Application of information technologies, software and tools applied to manage the environment
	6.5 Artificial intelligence for environmental data analysis
7. SOCIO-ENVIRONMENTAL TRAINING	7.1 Environmental Ethics
	7.2 Social Responsibility
	7.3 Leadership and Decision-Making in the socio-environmental Area
	7.4 Socio-environmental Public Policies
	7.5 Socio-environmental Governance

It is expected that this product will be consolidated as a reference tool for higher education institutions that will lead to strengthen both the graduate profiles and the curriculum in the area of environment with a Student-Centred Approach. This information can be found at the following link: https://erasmus-ace.com/medioambiente/

The rationale for each dimension and its respective sub-dimensions is explained below, and the respective tables (2 to 8) describe both dimensions and sub-dimensions in terms of learning outcomes from three elements: Knowledge, Skills and Responsibilities.

Dimension 1: Learning and knowledge management

In the context of student-centred learning, the teaching-learning process must provide the tools for the student to achieve autonomy in learning, to know his cognitive processes and to acquire the ability to manage his own learning process for the permanent generation of new knowledge beyond his academic life.

These are the competencies required of a student in the new knowledge society, also considering the variety of sources of information of different rigour and the ease of access to them. In this sense, the teaching-learning process should promote the formation of skills that allow what is known as Lifelong Learning or Self-regulated Learning (Torrano et al 2017, Nuñez et al 2006). Gairin (2007) proposes the concept of Self-Regulated Learning as that which relates to independent and effective forms of academic learning that involve metacognition, intrinsic motivation, and strategic action.

It is sought that the student, based on the learning and knowledge generated, is able to manage that knowledge to apply it adequately in the professional context in which he/she works. Thus, knowledge management involves: creation, transfer, storage, application and use of knowledge, and is configured as a systematic process for identifying, creating, acquiring, learning, sharing and using knowledge and experiences to achieve organisational objectives (Kumar, 2015). For this, the student needs to build a solid foundation that allows him/her to understand, as he/she advances in his/her academic training, each of the disciplines that will be presented to him/her with their corresponding difficulties; he/she will be able to advance satisfactorily as long as the foundations of his/her learning are laid in such a way that he/she can move from basic topics to more complex ones, and this is necessary not only for his/her role as a student but also as a future professional.

Considering this, the present dimension addresses the basis for the student to advance towards the following dimensions, achieving to enhance their ability to continuously develop in their professional life, as well as the ability to access rigorous information and research to encourage critical thinking and reasoning in a dynamic world. Likewise, the questions that students can generate from their interaction with society are important to achieve the construction of knowledge and personal growth. For this, it is also necessary to strengthen the management and educational processes that contribute to the autonomous formation of the student for the culture of learning and knowledge from the basic foundations of science. In fact, students should be aware of how they learn, providing opportunities for them to discover the good way to acquire, actively and consciously, the knowledge and skills necessary to be a good professional.

To this end, teachers have the mission to motivate, raise awareness, foster interpersonal relationships, and promote creative processes that motivate new generations to care for and conserve the environment (Valencia Celis et al., 2023).

In this sense, 6 subdimensions have been defined as necessary to generate the science bases required by students in degrees focused on environmental sciences, each one of them with the respective knowledge, skills, and responsibilities. The descriptors are shown in Table 2.

Table 2: Dimension 1: Learning and knowledge management and subdimensions

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Dimension 1: Learning and Knowledge Management	• Demonstrates a culture of continuous learning and knowledge in basic sciences and environmental sciences, among others, and their applications, using environmentally friendly methods and processes. • Develops the ability to understand knowledge in multiple disciplines, to abstract, analyse and synthesise them.	• Actively participates in the management of learning and knowledge of basic sciences and environmental sciences, their scientific foundations, their implications and applicability. • Develops the ability to apply their knowledge and knowledges to solve problematic situations and is committed to learn and train professionally to serve the context of the needs of the society in which they live.	• Demonstrates commitment to continuous updating and implementation of knowledge for professional development. • Builds knowledge and knowledge from theoretical or procedural production on environmental management.
Sub dimension 1.1 Basic Sciences	• Demonstrates understanding of basic science fundamentals and concepts in Mathematics, Physics and Chemistry.	• Integrates variables associated with mathematical equations, chemical equilibrium processes, kinetics, electricity and magnetism, matter and energy balance, thermodynamics, mathematical equations and graphic representations for	• Is committed to updating and building his/her knowledge of basic sciences.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
		the future analysis of environmental problems.	
Sub dimension 1.2 Natural Sciences	• Appropriates symbology and concepts on natural sciences: biological, geological, atmospheric, hydrological, soil, edaphological, chemistry (inorganic, organic and analytical), and other related sciences.	• Analyses natural processes and phenomena, the matter and energy involved, for the study of natural systems.	• Is committed to updating and building his/her knowledge in the natural sciences and to the interaction with the natural environment.
Sub dimension 1.3 Applied environmental science	• Demonstrates understanding of statistics, earth sciences, human, social and economic sciences, ecological, health, geomatics, chemistry and others for the improvement of environmental quality.	• Applies science learning to solve environmental problems with a contextualised integral vision.	• Implements the knowledge acquired in compliance with the established standards and under the sustainability approach.
Sub dimension 1.4 Sciences applied to Environmental Engineering	• Identifies water, hydraulic, cartographic and climatic systems, which will allow the development of environmental infrastructure works (green infrastructure) and quality environmental technologies.	• Develops hydric and energetic balances and applies them in cartographic and numerical modelling. • Projects and designs infrastructure works of environmental engineering and environmental technologies of quality. • Supervises and evaluates infrastructure works of environmental engineering and environmental technologies of quality. • Designs control systems that mitigate environmental impacts resulting from productive processes and operations.	• Is continuously up to date in science, technology and environmental engineering for the application of his/her knowledge in the improvement of the quality of life and the favouring of sustainability.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Sub dimension 1.5 Sustainable Production Processes	• Recognizes unit operations, input and output flows represented in the material balance and life cycle analysis of products and services.	• Integrates the methodology of unit process analysis to environmentally friendly productive improvements. • Develops eco-balance sheets for the formulation of clean development mechanisms.	• Ensures efficiency and effectiveness of processes while maintaining its commitment to the environment and social responsibility.
Sub dimension 1.6 Economy and Environment	• Recognizes principles of environmental economics, ecological economics, circular economics and economics for sustainable development in strategic planning, instruments and indicators.	• Manages circular economies at local or regional level applying knowledge in the environmental field.	• Commits itself to strive for the protection of natural resources.

Dimension 2: Contextualised environmental problem solving

The role of a professional, from the environmental perspective, but also in any other, does not follow a disciplinary logic, associated with the traditional paradigm of academic education, but does so through transdisciplinarity. From the undergraduate education, contents from various disciplines must be integrated, to be able to act on the resolution of real problems and contribute to the development of the community; understanding that they are complex problems and cannot be approached and/or solved from a single point of view. This is also based on a concept of horizontality of knowledge, where no one is superior to another, but each one from its specificity gives a valuable contribution to the understanding and resolution of problems and the development of the community. The transdisciplinary approach implies a series of teaching-learning processes based on theoretical-conceptual and procedural-operational knowledge, which is why it is required to recognize in the professional profile, both aspects associated with knowledge and skills, which together are affirmed in the autonomy and responsibility that the professional assumes and that is conferred by the community in which he/she acts. According to how he/she is able to attend to and manage these community problems and their context, a better or worse aptitude may be recognized to that same professional.

The problematization of knowledge, i.e. the organisation of knowledge around problems, is a challenge when it comes to systematising information and generating new knowledge. The role of a professional, from the environmental perspective, but also in any other, does not necessarily follow a fragmented disciplinary logic, associated to the traditional paradigm, but rather they do it from a transdisciplinary perspective, that is, from a plane of articulation of knowledge and knowledges that are transversal to complex problems, which require for their solution the articulation and integration of different and multiple contributions.

From undergraduate education, contents from multiple disciplines must be integrated, to be able to act on the resolution of real problems and contribute to the development of the community; understanding that these are complex problems and cannot be addressed and/or solved from a single point of view. This is also based on a concept of horizontality of knowledge, where no one is superior to another, but each from its specificity gives a valuable contribution to the understanding and resolution of problems and collaborate with the development of the community.

It is in the teaching-learning stage where the potential for transformation associated with the recognition of problems and solutions, in scientific-technological linkage, according to the development needs of the region, i.e. to be applied in recognizable and not abstract contexts, is apprehended. In fact, the lines of research should be oriented to the resolution of national and regional environmental problems. It is not only about teaching or learning knowledge but also about acquiring a skill, that in which experiences and knowledge built with and in community are put into play, with those who approach a real problematic situation and through in situ cooperation, with the aim of achieving real, possible, and validated approaches together with the population.

In this sense, 12 sub dimensions have been identified (Table 3), which constitute the role that a professional in the environmental field must face in his or her professional life for the contextualised solution of environmental problems. They have been grouped thematically in 4 fields:

- The first field, related to Problem Management, includes sub-dimensions 2.1, 2.2 and 2.3. It involves the use of instruments for the understanding of phenomena, aiming at the configuration of integral diagnoses, appropriate to the object of study.
- The second field is related to Project Management and includes sub-dimensions 2.4, 2.7, 2.8 and 2.12. It involves the approach from strategic planning, incorporating instruments and indicators of sustainability and identifying the necessary stages for the solution of problems through project management.
- The third field is related to Risk Management and includes sub-dimensions 2.5 and 2.6. It involves the identification and construction of scenarios for the formulation of comprehensive environmental risk management proposals, analysing life cycles and establishing improvements and preventive actions within the framework of climate change.
- The fourth and last field is related to Environmental Management and includes sub-dimensions 2.9, 2.10 and 2.11. It involves the participation and analysis of the environmental aspects and impacts involved in the implementation and execution of public and private projects, considering environmental laws and regulations from the perspective of integrated resource management.

Table 3: **Dimension 2: Contextualized solution of environmental problems and subdimensions**

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Dimension 2: Contextualized Solution of Environmental Problems	• Recognizes the characteristics of the case under study, of the territory where the problem has been identified, namely: characteristics of the population, housing characteristics, socioeconomic characteristics, among others, and then specifies the groups/actors/institutions that would be directly and indirectly affected.	• Demonstrates understanding of the context of the environmental problem and its complexity by identifying, analysing, and interpreting the causes, effects and their corresponding solution.	• Proposes solutions to environmental problems and articulates regulations with professional practice and the needs of the different stakeholders in an ethical and responsible manner.
Sub dimension 2.1 Problem identification and management	• Identifies phenomena from basic and applied sciences and from the approach of social and human sciences in the environmental context.	• Discerns between effects caused by natural and anthropic phenomena and their impacts. • Estimates the dimension of a problem or effect considering other sciences that can magnify the social impact. • Proposes solution strategies to the problem under study from the environmental field.	• Analyses situations and phenomena in a socio-environmental context that allows the anticipation of future scenarios, using basic and applied sciences.
Sub dimension 2.2 Analysis and understanding of	• Incorporates experimental and non-experimental testing tools and	• Proposes studies in laboratories and in the field.	• Proposes hypotheses by constructing validation

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
chemical, physical and/or biological phenomena.	devices and employs methodologies for hypothesis testing and validation.	• Selects the appropriate techniques and methods that allow him to easily interact with the phenomena and their context.	scenarios based on observations. • Justifies his/her analysis through the correct interpretation of the data they handle.
Sub dimension 2.3 Application of mathematics, science, and environmental engineering concepts	• Uses mathematics and other basic and applied sciences for the description, analysis and understanding of phenomena.	• Formulates theoretical models using abstract thinking. • Relates mathematical and scientific concepts in the field of application of environmental engineering.	• Uses modelling in forecasting environmental situations.
Sub dimension 2.4 Project Management	• Proposes, from a strategic planning perspective, sustainability instruments and indicators for the development of a project.	• Uses management techniques and project management methods for the execution of activities in a sequential and optimised manner. • Ensures productivity, development and environmental protection through project formulation, management and evaluation.	• Operationalizes the implementation of the necessary steps for the solution of problems through project management.
Sub dimension 2.5	• Identifies aspects related to environmental risk analysis,	• Evaluates environmental impacts through the construction of risk scenarios and formulation of	• Commits to the safety and health of people

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Comprehensive Risk Analysis	environmental health, environmental modelling and toxicology.	proposals for integrated risk management.	
Sub dimension 2.6 Prevention, Mitigation, Compensation of socio-environmental impacts	• Demonstrates expertise in integrated climate change management; biotechnology; environmental law; environmental education; environmental management; ecosystem and landscape restoration; biodiversity and protected area management; circular economy; renewable energy; applied geomatics and wastewater treatment.	• Acknowledges the mechanisms by which damage and contamination of the environment occurs. • Analyses life cycles establishing improvements and preventive actions.	• Demonstrates understanding of the consequences of climate change by proposing solutions to deal with waste and emissions based on current regulations.
Sub dimension 2.7 Project Development	• Structures the sequence of tasks to be accomplished for the construction of the desired solution.	• Projects creative, desirable and feasible solutions, technically and economically, in the contexts in which they will be applied.	• Develops projects applied to the environmental area as a response to socio-environmental problems.
Sub dimension 2.8 Sustainable Energy Development and Use	• Understands the processes of energy generation and transformation, as well as the impacts associated with the use of various sources considering the entire life cycle.	• Participates in the planning and implementation of projects aimed at energy generation with a view to sustainable development. • Participates in the elaboration of public policies in the context of the area.	• Contributes to the shift towards a less carbonised energy matrix and to the increase in the production of cleaner energy to meet consumer demand.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Sub dimension 2.9 Management of environmental issues	• Demonstrates understanding of the environmental aspects and impacts involved in the implementation and execution of public and private undertakings and the management actions for their prevention and reduction.	• Participates in the elaboration and execution of projects and planning actions for processes related to environmental management in the public and private sectors, by means of strategies consolidated in current legislation.	• Contributes to the adequacy of public and private companies to society's demands for sustainable development, considering the instruments of regulation and control (laws and regulations) and self-regulation (voluntary certifications).
Sub dimension 2.10 Environmental sanitation and services	• Demonstrates knowledge about the factors by which environmental pollution is produced and the aspects for the establishment of improvements and preventive actions.	• Analyses the integrated management of: solid, hospital and hazardous waste, atmospheric emissions, biotechnology, environmental management tools and their compliance with environmental regulations, ecosystem and landscape restoration, and the scope of renewable energies.	• Identifies the environmental regulations in force in the different areas.
Sub dimension 2.11 Utilisation and Quality of Hydric Resources	• Identifies hydric resources, surface and subway water bodies, their use, sources of contamination, management of resources for sustainable use	• Comprehensively manages liquid and gaseous emissions, wastewater treatment and associated climate change variables.	• Manages information by identifying the negative consequences of pollutants on ecosystem and human health.
Sub dimension 2.12 Science,	• Applies environmental projects taking into account the implications of the	• Provides clear explanations to communities about intervention	• Proceeds ethically reporting all actions that move away

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Technology and Society	impact on society, resulting from the application of science and technology to solve problems.	projects, using evaluation, consensus and dialogue tools. • Applies science and technology to solve socio-environmental problems.	from the protection of the planet and ensuring proper compliance with environmental regulations. • Assumes commitments with his/her country, for its development and environmental protection

Dimension 3: Research and development

Understanding the role of research in the formation of professionals in the environmental field contributes significantly to their performance, especially considering the challenges faced by this field. In addition to generating knowledge, environmental research seeks innovations to address challenges such as climate change, biodiversity loss, pollution, and scarcity of natural resources. Professionals in this area must have the ability to identify and address complex problems involving physical, anthropic, and biotic environments, as well as their interrelationships, considering political, social, and economic contexts, contributing to sustainable development strategies. Ensuring the effectiveness of solutions and their social relevance is essential to drive improvements in communities and the environment, considering the global context, while focusing on practical and applicable solutions at local and regional scales, where interventions can generate tangible and immediate impacts.

To this end, professionals in this area use data collection and analysis, the development of mathematical models and innovation to guide applied research that is aligned with the execution of research projects with a scientific and technological approach, guaranteeing real, reproducible, optimised results based mainly on the framework of consolidated and contrasted knowledge. Table 4 shows the descriptors for the dimension and each of the sub-dimensions.

Table 4: Dimension 3: Research and development and subdimensions.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Dimension 3: Research and Development	• Understands the role of research in the production of knowledge and the search for innovative solutions, technologies and processes for local, regional and international sustainable development, taking into account the political, social, economic and environmental contexts.	• Designs research whose results can be applied to local, regional and international sustainable development strategies. • Identifies contemporary problems in complex situations and contexts, taking effective actions in the decision-making process.	• Contributes with its scientific work to the sustainable development and continuous improvement of the local, regional and international community. • Guarantees the social impact of the research and the effective applicability of the solutions found.
Sub dimension 3.1 Data collection and analysis	• Develops sampling, data collection, mathematical treatment of both quantitative and qualitative results as the basis of any research, specifying the types, quality and measurement results, reproducibility and margin of error. • Applies statistical treatment based on computational analysis tools for data validation and its adequate interpretation.	• Evaluates the quality and representativeness of data, results and their application in research. • Applies different statistical software in the analysis of quantitative and qualitative data.	• Develops statistical validation processes based on standardised procedures, verifying the accuracy of data and results.
Sub dimension 3.2 Development of	• Demonstrates understanding of basic concepts related to the characteristics of the problem, analysis of linear and spatial statistical data, development of hypotheses	• Uses mathematical methods to find model solutions to the problem being addressed, through the formulation	• Verifies the proposed mathematical models by testing them in the context of an environmental problem.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
mathematical models	of different phenomena, mathematical modelling and use of appropriate computational methods for processing, analysis, modelling and validation of alphanumeric and spatial data.	of hypotheses and selection of the variables to be treated. • Interprets the results obtained from the application of specialised software, which contributes to the validation of the hypothesis and the solution of environmental problems.	
Sub dimension 3.3 Innovation	• Demonstrates understanding of the different technologies and scientific bases for the development of a product or innovation process.	• Interrelates different basic concepts through the application of holistic and disruptive knowledge. • Interprets reality justifying his hypothesis for the development of a material or innovation process.	• Implements new technologies for the development of solutions to new problems or substantial improvements to existing processes, always considering economy and immediate application.
Sub dimension 3.4 Applied research from Environmental Impact Assessment	• Applies environmental impact assessment methods according to environmental and social criteria. • Identifies updated national and international regulations related to environmental impact assessment.	• Evaluates factors, risks, influences and impacts of different processes or activities that may affect social, environmental and economic aspects, among others.	• Applies professional ethical criteria guaranteeing the preservation of natural and cultural resources in compliance with updated national and international regulations.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Sub dimension 3.5 Research project development and execution	• Uses different research methodologies, analytical measurement tools, implementation plans and standards in the execution of projects.	• Manages projects in whose development there is interaction with inter and multidisciplinary groups.	• Complies with the requirements and regulations for project development.
Sub dimension 3.6 Dissemination of scientific and technological knowledge	• Demonstrates familiarity with the main channels and media of academic, professional and general public dissemination.	• Expresses him/herself adequately, either in the native language or in other languages, including through the constant use of digital information and communication technologies (ICTD) • Demonstrates ability to synthesise information using appropriate strategies for each audience.	• Disseminates the results of projects for the solution of environmental problems according to ethical and professional principles, in accordance with current legislation and regulations.

Dimension 4: design and technologies applied to the environment

The dimension focuses on the development of essential competences related to environmental management and sustainability. This dimension has been formulated after a thorough analysis of current and future needs in the environmental field, as well as the growing importance of sustainability in the global society.

This dimension promotes the acquisition of fundamental knowledge that allows students to identify the components and tools necessary to design systems and measures for the integrated management of natural resources and pollution control in a context of sustainability. In addition, crucial skills are fostered, such as leadership in the implementation of technological and management solutions, using scientific tools and innovative techniques adapted to specific contexts.

Technological aspects are related to the main environmental problems, such as the integrated management of natural resources, climate change adaptation and mitigation, the incorporation of renewable energies and solid waste management within the framework of a circular economy. Students are expected to ensure that design methods focus on resilient design in the face of disaster risks and address sustainable production, also considering non-technical implications, such as social, health, safety, environmental, economic, labour and industrial aspects. This is always done in compliance with professional codes of ethics and respecting the applicable legal provisions. This dimension seeks to prepare students to address current and future environmental challenges, providing them with the necessary skills and knowledge to lead sustainable and responsible solutions in a constantly evolving world. Its descriptors are shown in Table 5.

Table 5: Dimension 4: Design and technologies applied to the environment and subdimensions

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Dimension 4: Design and Technologies Applied to the Environment	• Identifies fundamentals, as well as the different components and tools for the design of systems and measures for the integrated management of natural resources and pollution control in a context of sustainability.	• Leads technological and management solutions based on the design and use of scientific, technical and innovative tools adjusted to particular contexts and needs.	• Guarantees the design methods and their non-technical implications (social, health and safety, environmental, economic, labour and industrial) in compliance with the professional codes of ethics and respecting the applicable legal provisions.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Sub dimension 4.1 Development and application of technologies for the comprehensive management of natural resources.	• Analyses the dynamics and interactions related to natural resources: water, soil, air, energy and ecosystem services. • Applies engineering design parameters for the control of environmental damage and pollution in different natural resources.	• Designs strategies for the saving and efficient use of natural resources and ecosystem services. • Develops innovative technologies by applying existing technologies • for the prevention and control of environmental control of environmental pollution.	• Proposes designs of monitoring, control and treatment systems, with sustainability criteria, responding to the needs of communities, companies and other areas of performance; complying with professional codes of ethics and legal provisions.
Sub dimension 4.2 Application of technologies for mitigation and adaptation to climate change.	• Pronounces climate change phenomena based on the causes, collection, analysis and evaluation of relevant information.	• Simulates different scenarios associated with the effects of effects of climate change. • Proposes strategies for decision making in the prevention, solution and adaptation to climate change. • Proposes strategies for decision making in the prevention, solution and adaptation to climate change.	• Implements plans for prevention, mitigation and adaptation to climate change, articulating them with the needs of the communities.
Sub dimension 4.3 Sustainable energy management, design and	• Recognizes risk assessment, perception, communication, management, governance and policy methodologies.	• Apply risk analysis to hazards and threats taking into account the vulnerability of people and organisations, the public and private sector and society at local, regional, national or global level.	• Makes decisions based on disaster risk analysis at the local, regional, national or global level.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
implementation of renewable energies.			
Sub dimension 4.4 Sustainable energy management, design and implementation of renewable energy	• Demonstrates understanding of new technologies related to renewable energies for sustainable energy generation.	• Applies clean energy systems in public and private sector organisations.	• Proposes wind, solar, biomass, and photovoltaic energy systems, responding to the needs of communities, companies, and other areas of performance.
Sub dimension 4.5 Design of waste treatment and management systems	• Identifies the problems of waste generation and the implementation of treatment, disposal and recycling solutions to avoid environmental damage.	• Designs innovative environmental quality technologies for the efficient management and treatment of solid waste.	• Proposes strategies and guidelines for waste management and treatment, within the framework of collaborative work.
Sub dimension 4.6 Sustainable Production Design	• Identifies each productive process based on fundamentals and elementary concepts related to sustainable production	• Applies methodology of productive process analysis, identifying input and output flows represented in the balance of matter and energy.	• Ensures efficiency and effectiveness of the proposed production processes while maintaining its commitment to the environment and social responsibility.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
	design such as environmental terms, economy, sustainable technologies, industrial processes, material and energy balance, among others. • Performs life cycle analysis of products and services, proposing the management of sustainable production processes. • Evaluates the impact of production processes by measuring the environmental and social performance of an organization, using key indicators and evaluation tools.	• Develops environmentally sustainable productive improvement proposals.	• Promotes innovation and development of technologies, products and practices through an organisational culture based on sustainability.

Dimension 5: Assertive communication and collaborative work

In the education of engineering students in several countries, due to the nature of the study programmes and their students, the issue of communication is a critical factor. Universities in South America train students highly specialised in science, architecture and engineering, where there is a tendency to overvalue mathematics, physics, chemistry and computer science skills and there is a tendency to undervalue social and communication skills.

Today, leadership is essential in any activity and it is based on assertive communication and on knowing how to work collaboratively. We consider that one of the achievements of this project is to put assertive communication at the forefront of attention in order to be understood by its direct collaborators and the citizens, to whom we always have to explain and be accountable, in this sense, assertive communication is a fundamental tool.

With this background, it was proposed at the group level within the project to implement and design assertive communication strategies that promote improvements in interpersonal relationships; activities were thought of that would complement learning activities with motivational workshops. Similarly, sub-dimensions were designed (assertive communication and management of proactive communication) to help meet the specific objectives of the dimensional proposal of assertive communication and collaborative work. Also, organising students for teamwork is a critical issue, in general students should be responsible for their own learning and be capable and self-sufficient and there is a tendency to work individually, but collaborative work favours leadership in the business and social world.

Through the ACE Project it has been proposed to change the mentality of teachers and students by generating strategies through these types of dimensions that describe the development and the need to know how to work as a team. It is noteworthy the proposal in the sense of designing sub-dimensions that contribute to achieve the training goals and learning outcomes. Knowing how to work in a team is indispensable nowadays, not only in the field but also in a multidisciplinary team and collaborative work with the community as demanded by the environmental area. It is important to highlight the work of teachers and to promote this initiative in an empirical way by working on the subject, giving an important weight to the development of teamwork. It is also necessary to apply strategies that help to promote and create awareness in students about the importance of developing this skill for professional life. Table 6 shows the descriptors for this dimension and the three proposed subdimensions.

Table 6: Dimension 5: Assertive communication and collaborative work and subdimensions

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Dimension 5: Assertive Communication	• Demonstrates knowledge of elements necessary for assertive oral and written communication,	• Develops a culture of respect, empathy and honesty from the use of planning, which	• Demonstrates commitment to collaborative work with feedback from other

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
and Collaborative Work	as well as the reception of information that allows the establishment of interpersonal and multidisciplinary connections in different languages, supported by ICT.	contributes to the coordination of collaborative work.	stakeholders and respect for multiculturalism.
Sub dimension 5.1 Assertive Communication	• Communicates ideas in a clear and precise way, respecting their own criteria as well as those of others. • Uses tools to facilitate communication and expression of ideas in a positive way. • Demonstrates ability to integrate the diverse ideas and criteria of the members of the work team.	• Generates assertiveness and empathy with the audience, demonstrating coherence between the emotion and the message conveyed. • Uses appropriate and clear language according to the context and the audience. • Provides a good communicational atmosphere by adopting the other's perspective, thus achieving an effective and respectful communication.	• Expresses thoughts, knowledge and opinions in an honest, direct and respectful manner, managing information ethically.
Sub dimension 5.2 Pro-active Communication Management	• Communicates effectively through the submission of management documents in favour of the solution of sustainable situations in their community at a local, regional or global level.	• Effectively uses various models and formats with intelligent and convincing writing to present, before the corresponding instances, the results of the	• Demonstrates pro-active and socially sensitive contributions to solving environmental problems through efficient written and oral communication.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
	• Researches the different written and oral forms of communication in the pursuit of the feasibility of concrete facts.	resolution of problems related to the community.	
Sub dimension 5.3 Collaborative and Teamwork	• Demonstrates knowledge of strategies to work collaboratively and achieve common goals. • Integrates the capabilities of each of the team members to achieve constructive collaboration. • Demonstrates ability to negotiate the different positions within the work team. • Identifies the characteristics of each member of the team assigning the role that corresponds to each one for the realisation of a successful project.	• Leads work teams using strategies that maximise the participation of team members and allow the collective resolution of a problem or progress towards a common goal. • Manages the distribution of tasks to increase the efficiency and effectiveness of the team's operation.	• Achieves an adequate environment for collaborative work, generating respect among all team members and recognizing the effective participation of each member.

Dimension 6: Information technology management

This dimension addresses the challenges in the area of Information and Communication Technologies (ICT) for the environment subject area at the Latin American level, precisely when a digital revolution of the modern world is underway. This digital transformation is taking place at unequal rhythms where there is persistent disparity in the access and use of data and, in general, of Information and Communication Technologies. It is an opportunity for the

environmental area to make decisions based on data to have a deeper understanding of the world around us, recognizing the current limitations and the even greater need to keep in mind the credibility, quality, source, validity, authorship and integrity of the information used.

It is expected that with this dimension the meta-profile of the environmental subject area will be strengthened in the design and application of methodologies and procedures for decision-making in the environmental area based on information and focused on comprehensive and contextualised understanding and in favour of development to reduce digital divides and digital illiteracy. This implies knowledge of technologies and resources for the consultation, capture, processing, analysis, interpretation, visualisation, and dissemination of data, as well as the use of sensors for real-time monitoring of variables, incorporation of storage processes, debugging, maintenance and updating of alphanumeric and spatial data. This in an articulated way with knowledge in statistics, programming, and mathematics. With this purpose, Information Technology Management is defined based on the knowledge, skills, and general responsibilities of dimension 6, described in Table 7.

Additionally, five sub-dimensions have been incorporated which address the central elements of information technology management from the perspective and interest of the environmental subject area for its application in understanding and making decisions based on data and its application in: understanding and modelling of urban-rural environmental problems, water management, public health, alternative energies, clean energies, environmental impact, climate change, pollution control, waste management and in general the other areas of interest associated with the meta-profile. These are: Data mining: Search, generation, and systematisation of information; Real-time data system, collection and storage; Implementation of Geospatial technologies; Application of information technologies, software and tools applied to manage the environment and Artificial intelligence for environmental data analysis; each with their respective descriptors in terms of knowledge, skills and responsibilities.

Table 7: Dimension 6: Information Technology Management and subdimensions

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Dimension 6: Information Technology Management	• Demonstrates capacity for the design and application of methodologies, processes and functions required in environmental technologies	• Efficiently apply information and communication technologies in their work area.	• Applies various technologies in projects with a predictive approach to the environmental situation and projects that

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
	using software and hardware, identifying the benefits and limitations, promoting new technologies that are coupled to sustainability in order to collect data, evaluate, avoid, mitigate, remediate or compensate the environmental impact.		demonstrate solutions to various environmental problems.
Sub dimension 6.1 Data mining: Search, generation and systematisation of information.	• Demonstrates ability for the use of technologies and analysis of urban-environmental information. • Analyses statistical information, management and definition of observable samples and geo-referencing of geographic information. • Analyses territorial planning and zoning by means of Geographic Information Systems.	• Handles software for the systematic collection and processing of environmental information, cartography techniques and geographic information systems. • Manages data from the diagnosis, elaboration of conclusions and analysis of urban structure, vulnerability and risk maps.	• Generates infographics and cartography for urban-environmental decision making by building tools for priority setting.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Sub dimension 6.2 Real-time data system, collection and storage	• Identifies the different data structures and ways of storing them, as well as the methods and systems of data collection based on electrical and electronic devices. • Selects the data sources to be used.	• Implements data banks, integrating equipment for the creation of collection systems, selection of sources and maintenance of data.	• Maintains data integrity and ensures the operationalization of the acquisition system.
Sub dimension 6.3 Implementation of Geospatial technologies	• Demonstrates understanding of the theoretical foundations and spatial data involved in the applicability of geo technologies in the environment for the analysis and interpretation of the anthropic and non-anthropic environment. • Recognizes spatial data processing methodologies for modelling and simulation of scenarios for resource protection, risk management, socio-environmental vulnerability and climate	• Manages spatial data performing diagnostics for the elaboration of territorial and environmental management plans, based on evidence obtained from the application of geospatial technologies such as cartography, geographic information systems, photo interpretation, remote sensing and geostatistics. • Manages spatial data for the elaboration of territorial and environmental management plans, based on evidence obtained from the application of geospatial technologies such as cartography, geographic information systems, photo interpretation, remote sensing and geostatistics. • Applies models and simulations for the analysis of anthropic interventions, impact on	• Ensures the reliable use, credibility, accuracy and veracity of the spatial data and information identified and collected according to technical specifications and regulatory requirements. • Applies models and simulations taking into account the scope, limitations and potentialities according to the socio-environmental context.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
	change, both for urban and rural areas.	the natural environment, resource protection, risk management and natural hazards, socio-environmental vulnerability and climate change.	
Sub dimension 6.4 Application of information technologies, software and tools applied to manage the environment	• Identifies new technologies applied to environmental management. • Performs diagnoses, planning and execution of projects of environmental equipment and services in urban areas.	• Handles conflict resolution techniques and strategic instruments for social participation. • Analyses the regional context for land management by applying technological tools in their area of work, such as photo interpretation and remote sensing.	• Updates in the use of the different technological tools that exist to be applied in the environmental area. • Intervene in the improvement of the quality of life of the community through graphic representation of reality, sensitization and awareness raising.
Sub dimension 6.5 Artificial intelligence for environmental data analysis	• Demonstrates understanding of the importance of a process of generating information from collected data and how automation and data analysis supports decision making processes.	• Implements machine learning solutions and methods for the analysis and generation of information to enable decision making. • Identifies the various approaches and the differences between machine learning based techniques.	• Guarantees safe and reliable information from the data analysis process.

Dimension 7: Socio-environmental education

This dimension was chosen as it refers to a set of principles that guide training and education in socio-environmental issues, since these frameworks are used to structure and guide teaching in relation to the understanding, management and solution of problems related to social and environmental aspects. This framework establishes objectives for socio-environmental education, which include awareness and understanding of environmental problems, promotion of sustainability, citizen participation and the ability to address socio-environmental challenges.

Five sub-dimensions were defined: Environmental Ethics, Social Responsibility, Leadership and Decision-making in the socio-environmental area, Socio-environmental Public Policies, Socio-environmental Governance. With these subdimensions, topics related to the training of students are defined, such as conservation of natural resources, waste management, environmental justice, environmental ethics and the relationship between society and the environment. The Environmental Ethics sub dimension establishes the importance of norms and principles that are based on ethical components and standards established to guide the behaviour of organisations. These principles should include transparency, accountability, respect for human rights, equity, sustainability, and collaboration with stakeholders.

The Social Responsibility sub dimension is focused on companies and organisations, considering the impact of their actions on society, the economy, and the environment. In this context, emphasis is placed on concepts associated with sustainability, environmental education, social leadership, business ethics, project management and organisational design for social and business development and welfare. This framework can encourage organisations to constantly seek ways to improve their practices and results in this area.

In the sub dimension of Leadership and Decision-making in the socio-environmental area, the aim is to provide students with knowledge and tools for identifying, defining, and solving problems by making the right decisions according to their environmental context with a vision of the future to be able to predict changes and adapt to them, respecting the opinion of others.

The Socio-environmental Public Policies sub dimension seeks to achieve awareness of the organisational dimension of public policies: networks and actors, as well as evaluation processes, addressing the importance of compliance with current laws and regulations related to social responsibility, ensuring that the actions of the organisation are in accordance with legislation and established policies.

Finally, the socio-environmental governance sub dimension emphasises on socio-environmental problems affecting the communities and the importance of addressing aspects related to community involvement. The relevance of strengthening environmental institutions and conflict prevention through consultation and dialogue with the communities, involving them in decisions that affect their environment and livelihoods, is emphasised. It also emphasises the importance of involving stakeholders, such as employees, customers, suppliers, and local communities, in decision-making related to environmental issues.

For each of the subdimensions, knowledge, skills and responsibilities were defined, and exemplified in the repository with the Social Responsibility sub dimension, the activities that can be carried out for students to acquire the knowledge, skills and responsibilities described, in addition to including the learning methodology that can be applied and examples of evaluation related to the type of activities described.

Table 8: Dimension 7: Socio-Environmental Training and subdimensions

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Dimension 7: Socio-Environmental Training	• Demonstrates critical and analytical capacity on his self-knowledge, enhancing his emotional intelligence, which allows him to face with correct decisions the solution of environmental problems with ethics and social responsibility. • Advises in the design of public policies and regulations for their application. • Demonstrates understanding of multi-causal analysis and multiple consequences of socio-urban environmental problems, as well as human values, ethics and deontology. • Analyses local contexts, their problems and social actors.	• Articulates deontological knowledge and human subjectivity in the understanding of global contexts, environmental problems, making decisions that contribute to the harmonious and balanced socio-economic, cultural and political human development. • Is trained as a professional, continually updating his learning and applying all his knowledge to improve the quality of life of the planet.	• Applies ethical values that reinforce social responsibility by contributing to projects of conservation, restoration, use and respect for ecosystems, acting coherently through the principles of sustainability to achieve the common well-being of people, the economy and the environment. • Is empathetic, supportive and committed to solving environmental problems, favouring productive human development with environmental and social awareness. • Participates in judicial processes based on environmental protection, generating collective awareness, protection of natural resources and

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
			guaranteeing the humanization of knowledge.
Sub dimension 7.1 Environmental Ethics	• Demonstrates understanding of the principles and values to promote an ecologically sustainable, balanced and socially just and safe development with the environment and towards people.	• Proposes strategies framed in the common welfare between society and nature, through actions such as the protection, conservation and preservation of the environment.	• Demonstrates the capacity and commitment to regulate activities, taking care that the actions generated do not threaten the balance and development of the environment.
Sub dimension 7.2 Social Responsibility	• Demonstrates knowledge of sustainability, environmental education, social leadership, business ethics, project management and organisational design for social and business development and wellbeing.	• Contributes to the sustainability and social welfare of the communities by prioritising, responding and making decisions in response to the needs of the social environment.	• Demonstrates commitment in promoting participatory leadership schemes, promoting human and professional development, respect, preservation and regeneration of the ecological environment in each of the processes through a comprehensive approach between social and business development.
Sub dimension 7.3 Leadership and Decision-Making in the Socio-	• Demonstrates self-knowledge about his or her person with high levels of confidence, with a vision of the future to be able to predict changes and adapt	• Leads human groups in activities that benefit the sustainability and improvement of the processes and activities carried out in their field of work, respecting	• Looks after the interests of the group, of his work team so that the objectives of the decisions taken can be fulfilled, keeping control of conflicts and assuming the consequences to cope with the

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
environmental Area	to them, respecting the opinion of others. • *Acquires knowledge of tools for identifying, defining and solving problems by making the right decisions according to the environmental context.	the environment. *Analyses different alternatives and strategies for conflict resolution and management.	situations presented with responsibility.
Sub dimension 7.4 Socio-environmental Public Policies	• Identifies the concepts, importance and historical evolution of public policies associated with the environmental area. • Is aware of the organisational dimension of public policies: networks and actors, as well as evaluation processes.	• Carries out significant transformations through the design, planning, formulation and implementation of environmental public policies.	• Assists institutions in decision making and contextualization of solutions according to social, cultural and economic problems. • Demonstrates commitment to improving the reality of the most disadvantaged and vulnerable sectors, listening and reaching consensus on solutions in places where progress and development actions are implemented by applying science and technology in society.

Dimension & Sub dimensions	Knowledge	Skills	Responsibilities
Sub dimension 7.5 Socio-environmental Governance	• Recognizes measures to strengthen environmental institutions and prevent conflicts through consultation and dialogue with communities, involving them in decisions that affect their environment and livelihoods.	• Visualises the origin of the profoundly unequal distribution of costs and benefits of an economy highly dependent on the exploitation of natural resources that generates socio-environmental conflicts due to the aggressive expansion of extractive activities. • * Contributes to the reduction of the percentages of socio-environmental conflicts through assertive dialogues and solutions involving local, regional, national governments and citizens	• Applies mechanisms to strengthen governance processes and frameworks in a comprehensive and multi-level manner. • Supports society in education, in the definition of its goals and priorities and its direction towards cooperation, whether global, regional, national or local. • Promotes equity, participation, pluralism, transparency, accountability and the rule of law in a way that is effective, efficient, long-lasting, rejecting social discrimination

It is expected that this product will be consolidated as a reference tool for higher education institutions to strengthen both graduate profiles and curricula in the area of environment with a student-centred approach.