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Validation of the relevance of the graduation topics, with the training profiles of Environmental Engineers from the Technological Units of Santander, Colombia.

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Abstract

The Technological Units of Santander, Institution of Higher Education in Colombia, trains Environmental Engineers, for the validation of the training profiles of the program, from the thematic trends of graduation, we proceeded in a mixed methodology, based on the quantitative recognition of the quantity and focus of graduation projects, towards the qualitative recognition of the performance of the program. The graduation projects of the years 2016 to 2020 were reviewed, simple statistics were applied to look at representative loads of the thematic and within each of them, specific thematic trends were identified, this statistical quantification allowed to evidence, how they correspond to the profiles of the professional, established in the qualified registration of the program. A total of 896 degree projects were analyzed, 627 graduation of the technology level and 269 graduation of the engineering level; of these, the percentage of thematic areas of graduation are: Formulation and implementation of environmental technologies 2.8%; environmental impacts and pollution 80.49%; handling and management of biodiversity 12%; environmental legislation and territorial management 4.71%. The area of knowledge with the highest graduation is environmental impacts and pollution, corresponding to the profiles of basic sanitation, monitoring and pollution control and management of environmental studies; on the other hand, the area of knowledge with the lowest graduation is environmental legislation and territorial management, which in turn corresponds to the profiles of resource management and biodiversity and the instruments of territorial environmental management. From the results, biodiversity and territorial environmental management is not being evidenced in the

graduation areas, which is a graduation profile that is not having the transcendence that for the region and society should mean; it leaves the need to work from the research groups attached to the program, so that they develop more graduation spaces that can contribute to the repositioning of these profiles within the graduation of the program in its two levels of training.

Keywords: Training profiles, degree modalities, environmental engineering, degree project.

Introduction

Since the UN conference in Tbilisi in 1977, environmental education was presented as the fundamental global need to change human attitudes and behaviors towards the living environment. At the Rio de Janeiro summit in 1992, environmental education had strength and repercussion in the support of political and social leaders, included in the manifesto of the Millennium Agenda, ratifying it in 2015 in the 2030 Agenda and the Sustainable Development Goals SDGs (SDG, 2015).

The international dynamics towards sustainable development, entered in conjunction with the Political Constitution of Colombia of 1991, with the Ministry of Environment and the SINA, as columns of the Environmental structure of the Country, including environmental education for social transformation, from the National Policy of Environmental Education, recognizing academic programs in the environmental area as one of the main strategies.

Along these lines, in 2001, the Technological Units of Santander, UTS, created the Academic Program of Environmental Technology, framed within the area of knowledge of engineering and structured to train professional technologists to support environmental processes. By May 2012, through resolution 5445 of the Colombian Ministry of National Education, MEN, UTS was granted qualified registration for the Environmental Engineering academic program, and through resolution 5444, for the Environmental Resources Management Technology academic program, articulated by propaedeutic cycles.

The academic processes of the program were formulated under the development of competencies, ensuring the formation of an integral professional of the assistance and managerial order, with UTS identity, in: biodiversity management and territorial development, integrated management of water, air and soil resources, management processes and technological use of solid waste and project formulation, under the guidelines of sustainable development (UTS, 2018).

For the construction of the academic program that trains professionals in the environmental area, UTS has considered knowledge of physics, chemistry, mathematics, natural and social sciences, which allow them to characterize and locate natural resources, their potential, threats and possibilities for social use; identify, analyze and intervene, social needs and their search for satisfiers in natural resources as a primary source; and understand the productive processes of society, its use of natural resources, availability of environmental resources and waste that their use generates and deposits on nature. These aspects linked to the development of a society, require competent professionals to know, do and know-how, which is based on specific knowledge, its forms of application and understanding of reality and its transformation of processes and customs of life, all focused on welfare framed in sustainable development (UTS, 2018).

The Environmental Engineering program trains integral professionals from: Natural Sciences, in order to understand the behavior of living beings in their living environment and

how they provide means to live; Social Sciences, to understand human behavior, their needs and strategies to coexist and adapt to an individual and collective reality; and Mathematics, to quantify and explain processes and phenomena, which allow them to build their life scenarios and constantly improve them (Espinosa & Diazgranado, 2016).

With these general areas of knowledge as the basis of training, the specific curricular contents of the UTS Environmental Engineering program are structured under the components that are institutionally established for academic programs: basic, professional and socio-humanistic (UTS U. T., 2020). Basic Area: Integrated by disciplines of the basic sciences. In charge of providing the student with the bases and concepts, quantitative and analytical, necessary to provide solutions to real world problems. Professional Training and Deepening Area: Covers the theoretical and practical knowledge of the field of study of environmental resources and processes, from which to interpret the thematic problems that affect contemporary societies today, related to the handling and management of biodiversity; the deterioration and recovery of the quality of air, water and soil resources; the planning and development of the territory, as well as the study of scientific and technological options aimed at analyzing and solving environmental problems. Socio-Humanistic Area: In charge of presenting the knowledge related to the integral formation of the student and the understanding of the human condition and its relations in society. At the technological level and at the university level, this area comprises two training components, communication and humanistic, providing competencies for scenarios in reading-writing comprehension, communication skills, leadership, ethics and values (UTS U. T., 2018).

From the UTS, professionals are trained under modalities of propaedeutic cycles, first graduating professionals of technological level, in three years, and then, with two more years to achieve the title of Engineer. In the environmental area, UTS trains Technologists in Environmental Resources Management, for the fields of Environmental Laboratories, Field Technician for sampling, monitoring and pollution control; auxiliary of treatment plants PTAR's; Inspector of emission sources; Environmental Trainer; Project Resident; Solid Waste Manager. In the propaedeutic continuity, the formation of the Environmental Engineer will be able to perform in the fields of: Director of environmental projects; Environmental Resident; Director of environmental studies; Organize and Coordinate multidisciplinary teams; Environmental Advisor and Consultant; Official of Public Entities; Director of Processes (UTS U. T., 2018).

To validate the training approach of Environmental Engineers at UTS, the concordance with other higher education institutions, allowed ratifying the selection training and graduation areas, in which the academic program is located.

Initially from the department of Santander itself, the other academic offerings in the area contemplate:

The Environmental Engineer of the University of Santander (UDES, 2019) is prepared to identify and assess environmental problems, offer comprehensive solutions and promote sustainable development, evaluate the environmental aspects and impacts of a project, work or activity, generate plans and programs for preservation, mitigation, maintenance and conservation of natural resources; design treatment and optimization systems; and develop environmental and risk management strategies through the application of modern principles and techniques of environmental management.

From the Universidad Pontifica Bolivariana The environmental engineer applies the

solid foundation of mathematics and natural sciences to engineering to solve environmental problems of the communities, improving the quality of life of people in the region and in the country; designs treatment proposals for the conservation of natural resources (UPB, 2022).

From the Instituto Universitario De La Paz (UNIPAZ, 2020), the Environmental Engineer formulates, executes and evaluates studies and projects related to the environmental and sanitation sector that promote sustainable and sustainable development; develops and applies environmental management tools for the preservation, use, exploitation and integrated management of natural resources, as well as those aimed at the mitigation and control of pollutants, ensuring compliance with legal standards; plans and designs water treatment plants, atmospheric pollution control systems and integral solid waste management, as well as designs and implements urban and rural environmental planning strategies, articulated with zero emissions and zero dumping policies through the adequate management of the territory on a regional and national scale.

In the same approach, the training of Environmental Engineers from the main universities in Colombia, present their proposals:

From the Universidad de los Andes the Environmental Engineers with solid bases in physics and mathematics, complemented with knowledge in economic-administrative and social areas, which allows them to lead both the structuring and planning of environmental engineering projects, as well as the design and execution of such projects for the prevention, mitigation and correction of the country's environmental problems (UNIANDES, 2021).

At Universidad El Bosque de Bogotá, Environmental Engineering provides tools in planning and environmental management of alternatives that advocate the sustainable use of natural resources; design and management of clean technologies for the prevention, control and management of pollution factors; design of research and development proposals for the implementation of alternatives that contribute to the mitigation and adaptation to climate change; planning, design and management of projects for the comprehensive management of water resources; guidance and implementation of plans, projects and research, transfer and innovation activities; design and implementation of comprehensive management systems (UEB, 2019).

The Environmental Engineer of the UCEVA (UCEVA, 2019), is a professional capable of identifying, understanding and proposing alternative solutions to environmental problems, using scientific and technological knowledge, seeking sustainable development and with it, the harmonious coexistence with nature for a better quality of life for the benefit of man, optimizing processes and minimizing cost.

From another approach, the environmental engineer of the University of Medellin designs environmental solutions that contribute to the sustainability of organizations and regions to prevent, mitigate and control environmental impacts, valorize waste and manage natural resources and the environment, in addition to formulating projects for the identification, characterization, organization and optimal quantification of resources, processes and activities over time and apply the regulatory framework, public policies and national and international standards of environmental management that allow relevant environmental actions (UNIMED, 2019).

From the Universidad del Valle, the Sanitary and Environmental Engineer is a professional for the prevention and control of pollution of natural resources water, air and soil,

contributing to the development of productive sectors, the protection of public health and ecological balance. Who understands the broad effects and benefits of environmental systems and processes on human health and collective welfare; as well as the role and responsibility of public institutions and private organizations in the management of the environment; also prepared to develop teamwork or lead multidisciplinary groups, who recognizes the need for learning and development of skills continuously over time (UNIVAL, 2015).

At the Universidad Autónoma de Occidente, (UAO, 2020), Environmental Engineering trains professionals to perform in areas of entrepreneurship towards environmental consulting, which is developed in function of the State projects and in the different productive sectors, contributing in competitiveness through the design and implementation of clean production programs; the direct provision of services such as water supply and removal, collection and treatment and disposal of solid waste. Being environmental authority exercising state control over the activities of the different productive sectors and the population in general, public administration, participating in the environmental dimension of development planning, in international organizations from the design and operation of projects for sustainability, also from teaching and research.

From the Universidad Santo Tomas (Cuéllar & Méndez, 2015), they analyzed the thematic and methodological trends of the research projects of the students of the undergraduate program in environmental education and community development of the faculty of education of the Vaud, to determine the thematic trends, the research approaches of the undergraduate program with a view to developing new academic proposals and continue supporting the construction of lines of research and research projects. All this with the aim of continuing to broaden the arguments on how Environmental Education has been conceptualized.

From the Universidad Distrital Francisco José de Caldas, in Bogotá, carried out the analysis of the Trends of Research, Application and Deepening of the Degree Works in Forest Engineering in the period 2015-2018 (Cuellar & Carvajalino, 2019), with which it seeks to analyze the trends of research, application and deepening of the degree works in forest engineering in the period 2015-2018 having as objectives the characterization of the different degree works, in addition, to identify the usability of statistical methodologies for information processing in the different fields of knowledge of the professional profile and to contrast the fields of knowledge of the professional profile of forestry engineering at the Universidad Distrital Francisco José de Caldas, looking for application trends.

Materials and Methods

The research process, was developed under quantitative approach (Hernandez, Fernandez, & Baptista, 2014), taking from the database of registration of degree projects of the UTS, between the years 2016 and 2020, 269 engineering projects and 627 projects of the environmental technology program. With this, characterize the formative trends of the degree projects, in relation to the training profiles, as a support of the approach established from the professional competencies of each program.

Given that the Environmental Engineering program at UTS is offered under a propaedeutic cycle modality, the analysis contemplated the behavior at each level and the general behavior of the entire program.

The research sought to characterize the formative tendencies of the degree projects

developed by the environmental technology and engineering programs of the UTS, in relation to their training profiles, as a support for the approach established from the professional competencies of each program. The degree projects generated between the years 2016-2022 were classified according to their training areas defined in the formulation of each program.

With this, the relationships between degree project and training profiles of the program were established, which allows evidencing priorities in the graduation of students, and tendency towards the realization of degree projects and evidenced the areas of knowledge and training profiles, in which the efforts of the students' degree project will be focused, as a strategy of integrity of the academic program and institutional strength in the academic offer of engineering (Cuéllar & Méndez, 2015).

The projects or degree works were regrouped, by thematic areas, according to the main aspects on which the environmental processes are focused. This classification was related with pertinence to each of the areas of performance, which the academic offer is registered with the Colombian Ministry of National Education. By simple statistics (Aragón, 2016), the ranges of representativeness by subject matter were established within each subgroup and of these in the work performance areas established by the UTS. Through the professional profiles of each program, the relationship between area of study vs. training profile of the professional is established in order to demonstrate the priorities of the students and the trends towards the completion of the degree projects of the technology and engineering programs, and at the same time it is analyzed according to the field of action of the professional, which knowledge was applied for each degree project.

The relationship between the percentages of thematic subgroups of degree projects with the areas of training of the program determined the weights of each area of training in the degree projects, determining the area of greater and lesser representative weight. The number of degree projects that belong to each area of study and their percentage were quantified, and consequently the number of degree projects according to the knowledge applied was quantified in order to show which areas of study the students are focusing more on and which are not.

In addition to analyzing in which areas the programs are strong, in which they are minimal, in which they are not strong and those that do not belong to the professional profiles; therefore the university should look at what to do with those that should be improved and which definitely do not belong to the professional profile, so that the university incorporates to the program what it needs for those degree projects to have the support of the professional profile to have, or if it definitely does not correspond to the professional profile the degree project committee should be careful not to accept project in these areas because they do not correspond to the professional profile (Cuellar & Carvajalino, 2019).

With this comparative, some appreciations are exposed with the intention of contributing to the program, in knowing the areas in which it should reinforce the training to strengthen the degree projects and the areas in which it should improve the execution of projects, all in order to strengthen the academic offer and relevance of the environmental engineering program UTS, in the solution of the needs of the population (Cuellar & Carvajalino, 2019).

Results and Discussion

From the database of the UTS, the degree works of Technology and Engineering students were selected as the statistical sample to be worked on. On the other hand, in

accordance with the approach of the different institutions offering environmental engineering and what is stated in the master document of qualified registration, the areas of knowledge of the environmental engineer and the profiles of the professional or professional areas in which the UTS environmental professional is expected to work were specified.

The areas of knowledge and training profiles were identified as follows:

Areas of knowledge in the environmental resources technology program:

Environmental impacts and contamination: Environmental contamination is the presence of harmful components that are detrimental to the living beings that inhabit it, including human beings, and environmental impact, also known as anthropogenic impact or anthropogenic impact, is the alteration or modification caused by human action on the environment. Because all human actions have an impact on the environment in some way.

Biodiversity management: is the adoption of good environmental and agricultural practices such as: identifying protected areas and natural ecosystems, avoiding the degradation and destruction of ecosystems, establishing buffer zones that prevent the alteration of ecosystem equilibrium, maintaining-restoring and increasing canopy cover, and protecting native trees.

Basic technology training: knowledge of basic sciences applied in the analysis and intervention of environmental situations derived from the multiple activities and behavior of human beings.

And, Occupational Health: Relationship between environmental pollution and health problems in the population, which includes the analysis of exposure to pollutants and vectors associated with various diseases, through multiple environmental matrices and their different routes.

Areas of knowledge for the Environmental Engineering program were also identified as follows:

Evaluation of environmental impacts: a preventive tool that seeks to avoid or minimize the environmental effects of any human activity on the natural environment and people.

Sustainable management of biodiversity: includes the processes through which actions for the conservation of biodiversity and ecosystem services in the social and territorial scenario are planned, executed and monitored.

Environmental legislation: Environmental legislation (environmental law) is a complex set of treaties, conventions, statutes, laws, regulations, which in a very broad way, work to regulate the interaction of humanity and the rest of the biophysical components or the natural environment, in order to reduce the impacts of human activity, both in the natural environment and in humanity itself, in the case of Mexico, it is well known that it has an immense natural wealth, animal species, flora, precious woods, reefs, among others.

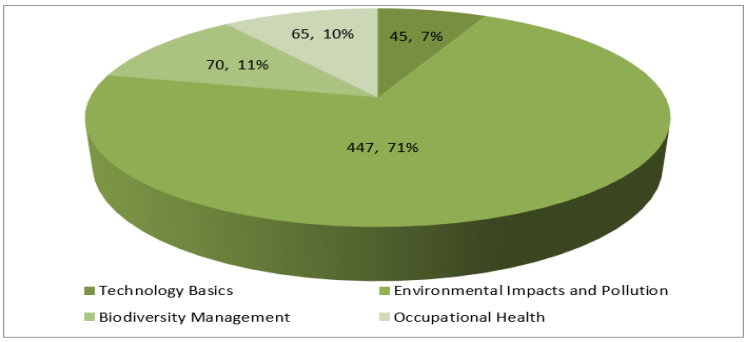
Geographic information analysis: integrate, store, edit, analyze the referenced geographic information, and thanks to this analysis we can find an environmental impact assessment, urban planning, cartography, among others.

The number of degree projects was 269 engineering projects and 627 projects of the

environmental technology program, classified by thematic or study areas, the following information was obtained.

From the topics covered in each degree project, they were qualified, seeking to group them in approaches that would facilitate the approach to the areas of study and the training profiles of the professionals of the academic program. This process generated the identification of the knowledge covered in the graduation process of technologists and engineers, from these, to find their relevance with the areas of study, contemplated from the academic offer of the curriculum and the official registration of the program, and from these areas, to establish the relationship with the professional profile, achieving the fundamental purpose of the research, to relate graduation and training profiles.

Table 1 shows the relation of the graduation projects of the technology program, grouping them by topics related to the knowledge that is imparted from the subjects that make up the program, to focus them in one of the four areas of general knowledge that consolidate the academic identity of the program and from which the professional who graduates as technologist in environmental resources is supported.



Graph 1. *Distribution of graduation works by Areas of Study of the Environmental Resources Management Technology program.*

Table 1. *List of projects, by areas of knowledge in the environmental resources' technology program.*

Applied Knowledge	Projects by Topic		Knowledge Area	Projects by Area	
Analysis of physical and chemical quality of resources	29	64%	Technology Basics	45	7%
Support to sampling, data collection and reading processes of environmental applications and services laboratories.	16	36%			
Accompanying the formulation or implementation of basic environmental sanitation plans.	107	24%	Environmental Impacts and Pollution	447	71%
Execution of environmental education campaigns on waste management.	209	47%			
Monitoring and control of resource contaminant affectation.	110	25%			
Accompanying the development of eco-efficient processes in the use of resources.	21	5%			
Environmental education in ecological restoration projects	49	70%	Biodiversity Management	70	11%
Environmental management for the identification, reforestation, protection and conservation of ecosystems.	10	16%			
Formulation and monitoring of school environmental projects	11	14%			
Support to occupational health and work environment programs.	65	100%	Occupational Health	65	10%
Grand total				627	100,00 %

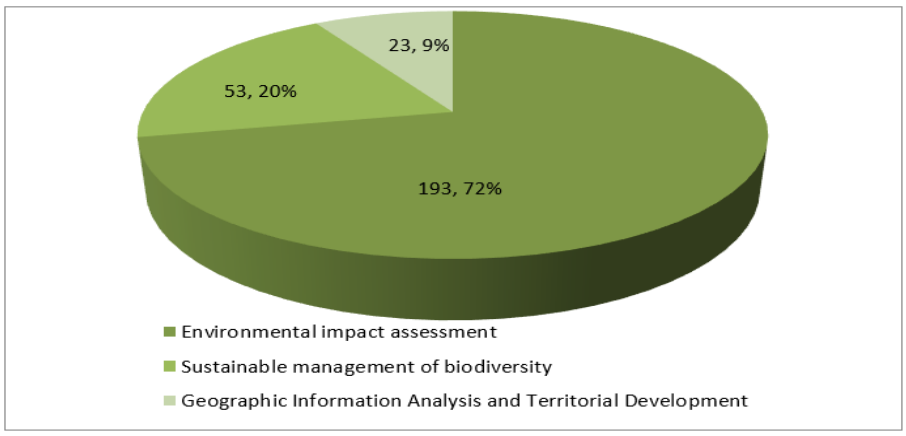
Once the projects were identified, it was meaningful to regroup them by areas of study, since this showed the main focuses on which the validation of the professionals in the programs was achieved. Graph 1 shows the distribution of projects in the referred areas of study.

It is noteworthy that these project classification areas are framed with the areas estimated by the Colombian Ministry of National Education for the training of engineers, where basic sciences, knowledge applied to engineering and humanistic training are considered pillars in this area of higher education (MEN-SNIES, 2021). Similarly, there is a significant coincidence with the conception of the duty to be of the programs in the environmental area of other higher education institutions, in which training for resource management constitutes a strong pillar of study (Cuellar & Carvajalino, 2019), together with the management of environmental impacts or alterations to resources, as a pillar of welfare of society (UAO, 2020), (UPB, 2022), likewise the management of sampling and laboratory analysis, is an activity contemplated in those institutions where technologists or bachelor's degrees are formed (UAO, 2020), (Cuéllar & Méndez, 2015), given that in institutions that form only environmental engineering degree, this activity is not highlighted within their interest.

The technology program of the UTS, shows results in the area of business environmental management, from the occupational health component, this is not named in the same way by the other institutions and references analyzed, although in some of them business environmental management is highlighted, as a necessary axis of environmental work (UCEVA, 2019), (UNIMED, 2019), although they are specific in the performance management approach of the entity, but not in the occupational health approach as presented by the UTS, this particular may have a double interpretation: it may be a field that does not fall within the competence of the environmental professional, or it may be a differentiating component of the quality of the academic program at UTS.

It should be noted that within the current approach to training professionals in the environmental area, importance is given to the sustainability component, this is the central axis of the research process in the environmental resource technology program at UTS (UTS U. T., 2018), but even so the degree projects do not evidence specific thematic in this sense, which highlights them within the areas of knowledge of the program. For institutions such as the Universidad de los Andes, in Colombia, this sustainability approach is a fundamental pillar of their professional training (UNIANDES, 2021), because what has to be an approach that should be thought from UTS to strengthen it in the program.

Table 2 shows the list of undergraduate projects in the engineering program, grouped by topics related to the knowledge taught in the subjects that make up the program, to focus them on one of the three areas of general knowledge that consolidate the academic identity of the program and support the professional who graduates as an environmental engineer.



Graph 2. *Distribution of graduation works by Areas of Study of the Environmental Engineering program.*

Table 2. *List of projects, by areas of knowledge in the environmental engineering program.*

Applied Knowledge	Projects by Topic		Knowledge Area	Projects by Area	
Assessment and evaluation of environmental impacts in infrastructure projects.	133	65%	Environmental impact assessment	193	72%
Analysis of scopes, causes and environmental consequences of productive processes.	26	13%			
Processes of management research, control, intervention or recovery of environmental variables.	45	22%			
Generation of strategies for the protection, conservation and restoration of ecosystems.	46	87%	Sustainable management of biodiversity	53	20%
Responsible for intervention, management and control of different mechanisms for resource use.	7	13%			
Formulation of strategies for the optimization of ecosystem services of resources.	14	61%	Geographic Information Analysis and Territorial Development	23	9%
Formulation, implementation and monitoring of sectoral plans for territorial environmental management and application of public environmental policies.	9	39%			
			Total general	269	100,00%

Once the projects were identified, it was meaningful to regroup them by areas of study, since this showed the main focuses on which the validation of the professionals in the programs was achieved. Graph 2 shows the distribution of projects in the referred areas of study.

The classification of projects in the engineering program, in addition to agreeing with the areas of engineering education of the Colombian Ministry of Education, defines the three fields specific to the UTS program, which correspond to the approaches of other academic programs taken as a reference. There is a strong similarity with programs that incorporate the evaluation and management of environmental impacts as a fundamental purpose of the engineering professional (UAO, 2020), (UDES, 2019), (UPB, 2022), expressing its management and recovery for social welfare, in the same way, other academic offers, include and are specific in the importance of resource management, associating it to the management of anthropogenic impacts (UNIVAL, 2015), (UNIMED, 2019).

An important condition that the degree projects show is the development of the sustainability component in the UTS program, which coincides with the work approach specifically from the Universidad de los Andes (UNIANDES, 2021), and although it is not highlighted as a fundamental axis of training, other academic offers of training in the environmental area highlight sustainability as a necessary axis of development and the contribution of the professional (UPB, 2022), in addition to making tacit the contribution of the environmental engineer with objective information of the reality for decision making that affects the consolidation of society and the way it relates to natural resources (Cuéllar & Méndez, 2015) (Espinosa & Diazgranado, 2016).

It is noteworthy that the area of municipal environmental management is a strength of the UTS engineer, framed in the management of territorial information, since from here it is explicitly mentioned, other professional offers, mention it within their bets, without highlighting it as an axis of their training (UNIANDES, 2021), (UNIVAL, 2015), (UAO, 2020), that although it is evident in their offer, it is not an element of significant importance or that stands out as one of their primary contributions. This is a field of training that should continue to be promoted by the UTS, since it is a particular and differentiating strength in the training of environmental engineers.

With the analysis of the preceding information, the relationship of the degree projects to the professional profiles of the program was established, given that from the curricular structure in force in the qualified registration of the program, the profiles are supported in the areas of training, these in the distribution of subjects, and the subjects in the development and application of knowledge.

The areas of knowledge are related to the professional profiles of the programs, therefore it is possible to relate the degree projects to the professional profiles and verify the approaches in which the graduation trend is taking place in the technology and engineering programs. These areas are related to the training profiles, also by program levels. Table 3 shows these relationships.

Table 3. ***Area of Study vs. Professional Profile***

Environmental Resources Technology Program	
Area of Study	Professional Profile
Environmental impacts and contamination	Identifies environmental impacts recognizing the causes and consequences generated by different alterations and support the process of recovery and management of environmental licenses.
	Develops and implements integrated solid waste management plans to reduce pollution levels in natural resources.
	Determine the levels of contamination of water, soil and air resources by means of their physicochemical characterization and in order to establish the necessary actions for their recovery.
Biodiversity management	Establish mechanisms for the conservation and preservation of ecosystems in the region to contribute to the quality of life of the population.
	Develop environmental education campaigns in communities and organizations to promote behavioral and procedural changes that favor better environmental conditions.
Occupational Health	Participates in environmental management and environmental planning processes of an organization to minimize impacts, taking into account current regulations.
Basic technology	Use specialized laboratory equipment for physical, chemical and biological analysis to characterize the resources and control their environmental conditions.
Area of Study	Environmental Engineering Program Professional Profile
Evaluation of environmental impacts	Designs environmental management plans in resource use projects to plan mitigation actions, compensation and restoration of affected areas according to current regulations.
	Designs and implements systems for the treatment and use of water, wastewater and solid waste, for the protection and conservation of resources, in accordance with current regulations.
Sustainable management of biodiversity	Generates sustainable strategies and mechanisms for the integral management of climate change and the use of natural resources to improve the living conditions of the population.
	Leads advisory and consulting teams for productive processes, managing the use of resources to minimize their impacts.
	Designs guidelines for the application of resource bioremediation technologies, under sustainability criteria.
Geographic information analysis	Designs integral projects of environmental education and citizen training to generate habits and customs of life in balance with nature.
	Directs territorial development processes that allow the sustainable use of natural and environmental resources to improve the living conditions of the population.

Once the professional profiles have been established, they bring together the aspects in which the professional is competent in specific activities, which are not the only ones, but in which the strength and belonging of the academic offer of the STSU in the environmental area is best expressed, thus recognizing potential work spaces to be occupied by technologists or engineers. By cross-referencing this information with the classification of degree projects, it is possible to infer which profiles have a greater tendency in the graduation projects and in which labor spaces there may be a better or greater presence of professionals from the UTS.

Table 4, for the environmental resources program and Table 5 for the environmental engineering program, show the distribution of degree projects in the professional profile and their weight on the components of the profile that are related to a specific professional activity. This shows specifically, in quantities, which is the work activity to which most graduation projects are directed and allows analyzing in which areas of knowledge to strengthen academic training and which to reinforce in order to increase the professional presence of the graduates of the technology and engineering program.

Table 4. *Relationship of graduation projects to the components of the professional profile of the environmental resources technology program.*

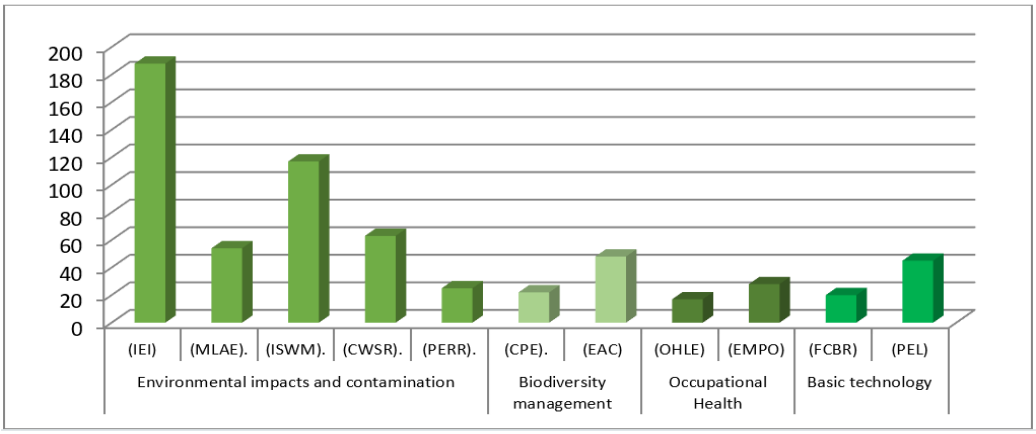
Environmental Resources Technology Program						
Area of Knowledge	Graduate Projects		Professional Profile	Components of the Professional Profile	Graduate Projects	
Environmental impacts and contamination	447	71%	Identifies environmental impacts recognizing the causes and consequences generated by different alterations and support the process of recovery and management of environmental licenses.	Identification of environmental impacts (IEI)	188	42%
				Management of licenses, authorizations or environmental processes (MLAE).	54	12%
			Develops and implements integrated solid waste management plans to reduce pollution levels in natural resources.	Elaboration and execution of integrated solid waste management plans (ISWM).	117	26%
			Determine the levels of contamination of water, soil and air resources by means of their physicochemical characterization and in order to establish the necessary actions for their recovery.	Contamination of water, soil and air resources (CWSR).	63	14%
				Proposals for environmental recovery of resources (PERR).	25	6%
Biodiversity management	70	11%	Establish mechanisms for the conservation and preservation of ecosystems in the region to contribute to the quality of life of the population.	Conservation and preservation of ecosystems (CPE).	22	31%
			Develops environmental education campaigns in communities and organizations to promote behavioral and procedural changes that favor better environmental conditions.	Environmental education campaigns (EAC)	48	69%
Occupational health	45	7%	Participate in environmental management and environmental planning processes of an organization to minimize impacts, taking into account current regulations.	Occupational health and labor environment (OHLE)	17	38%
				Environmental management and planning of an organization (EMPO)	28	62%
Technology basics	65	4%	Use specialized laboratory equipment for physical, chemical and biological analysis that allow the characterization of resources and the control of their environmental conditions.	Physical, Chemical and Biological Analysis of Resources (FCBR)	20	31%
				Processes in environmental laboratories (PEL)	45	69%

Graph 3 shows that in the environmental resources technology program, the area of knowledge with the greatest contribution to graduation projects is environmental impacts and contamination, and within this, the professional profile component of impact identification. On the other hand, the area of knowledge that contributes the least to graduation projects is

occupational health. It is clear that the area of basic technology has significant room for growth, since the processes of analysis and laboratory work are a strong area of work for the technologist in environmental resources at UTS.

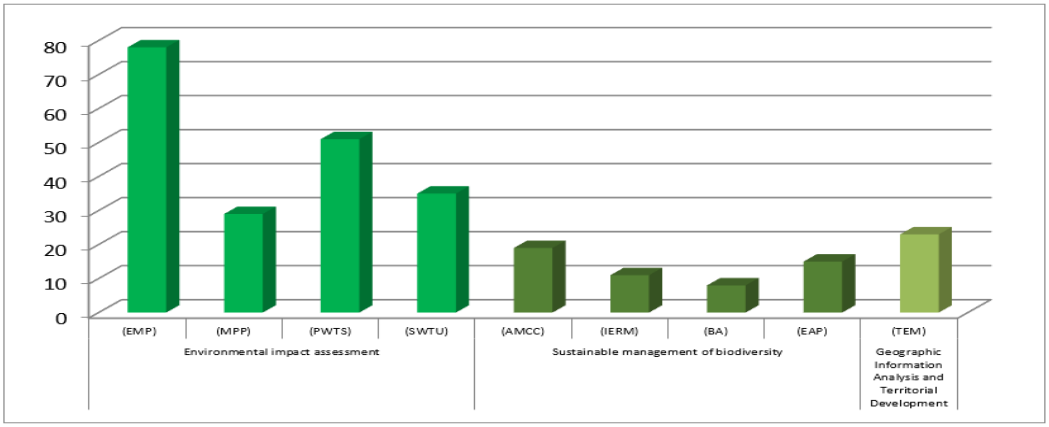
Tabla 1. *Relación de proyectos de grado a los componentes del perfil profesional del programa de ingeniería ambiental*

Environmental Resources Technology Program						
Area of Knowledge	Graduate Projects		Professional Profile	Components of the Professional Profile	Graduate Projects	
Environmental impact assessment	193	71%	Designs environmental management plans for resource exploitation projects to plan mitigation, compensation and restoration actions for affected areas in accordance with current regulations.	Environmental Management Plans (EMP)	78	100%
			Leads advisory and consulting teams for productive processes managing the use of resources to minimize their impacts.	Management from the productive processes (GPP)	29	100%
Sustainable management of biodiversity	53	20%	Designs and implements systems for the treatment and use of water, wastewater and solid waste, for the protection and conservation of resources, according to current regulations.	Potabilization or Water Treatment Systems (SPTA)	51	59%
				Solid Waste Treatment and Utilization Systems (TARS)	35	41%
			Generates sustainable strategies and mechanisms for the integral management of climate change and the use of natural resources to improve the living conditions of the population.	Adaptation and mitigation to climate change (AMCC)	19	63%
				Integrated environmental risk management (IRM)	11	37%
			Designs guidelines for the application of bioremediation technologies for resources, under sustainability criteria.	Biotechnology Applications (AB)	08	100%
			Designs integral projects of environmental education and citizen training to generate habits and customs of life in balance with nature.	Environmental education processes (PEA)	15	100%
Geographic Information Analysis and Territorial Development	23	9%	Directs territorial development processes that allow the sustainable use of natural and environmental resources to improve the living conditions of the population.	Territorial Environmental Management (GET)	23	100%



Graph 3. *Relationship of projects between areas of knowledge and components of the professional profile in the environmental resources technology program.*

Graph 4 shows that in the environmental engineering program, the area of knowledge with the greatest contribution to graduation projects is the evaluation of environmental impacts and within this, the professional profile component of environmental management plans. In contrast, the area of knowledge that contributes the least to graduation projects is the analysis of geographic information and territorial development, although the professional profile in which there is less evidence of graduation projects is in Biotechnology Application, which is related to the area of sustainable management of biodiversity, an area in which there is an important number of graduation projects. The two areas of knowledge of sustainable management of biodiversity and analysis of geographic information contribute to important work spaces, for which the degree projects in these areas should continue to be strengthened.



Graph 4. *Relationship of projects between areas of knowledge and components of the professional profile in the environmental resources technology program.*

Conclusions

The review of the degree projects presented in the environmental resources technology programs and its environmental engineering program, are in accordance with what was formulated by the program, respond to the contents designed in the subjects of the academic offer of the program and show that the intention is to demonstrate that the competencies and learning outcomes are supporting the proposed professional profile. This is an important evidence of the relevance of the academic program to the labor needs and expectations of society, since the degree projects, as the first step of the students, to meet the needs of the population, have been built on topics felt in the territory.

In the propaedeutic training modality of the program, technology and engineering, have a consolidated focus on the attention of environmental impacts, which is logical with the duty to be of environmental knowledge. At both levels, the largest load of undergraduate projects develops attention and response to processes associated with environmental impacts, solutions are proposed and interventions are formulated, which are aimed at improving three aspects: one, the living conditions of the population; two, the interaction or use of natural resources; and three, the environmental performance of companies. Impacts and pollution and impact assessment are the areas with the highest percentage load of degree projects at both levels, coinciding numerically in 71%, an important evidence of the effective continuity of the training and the clear focus on the attention to social situations and alteration of the living environment. The program must continue to strengthen this training to ensure that its graduates continue to have competencies focused on addressing the environmental impacts generated by human activity.

The aspects associated with the handling and management of biodiversity are an important component of analysis in the environmental vision, given that from biodiversity come all the natural resources with which man supplies his needs, therefore the training and expertise in this area is fundamental for professionals in the area to be in charge of the balance in the social use of biodiversity, in such a way that the needs of life of the population are met, but the minimum respectable resources are contemplated so that these continue to exist and therefore real actions are directed towards the sustainability of the resources as a source of life for society.

The sustainability component is not evident in the undergraduate projects of the technology program, which is understandable, given that the formation of competencies and the focus of the learning results of this level are focused on know-how, therefore the great load of projects is oriented to the development of actions for specific and immediate results, logically linked to the development process, but with all the focus to perform tasks or actions of immediate results. The undergraduate projects at the engineering level, on the other hand, undoubtedly contemplate the sustainability component, as evidenced in the solution approach they propose, in which the use of resources and the projection of their existence and that of society in balance are being contemplated. At the engineering level, there are projects that develop proposals based on the Sustainable Development Goals SDGs, which gives the program a remarkable impact in its intention to contribute and respond to global development approaches through the UN 2030 development agenda.

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