TOWARDS A RESPONSIBLE ENGINEERING: THE INCORPORATION OF THE ENVIRONMENTAL SCIENCES STUDY IN THE ENGINEERING EDUCATION.

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There are special cases constituted by new matters or subjects in which the society searches for professionals, and that had arisen as a result of their same evolution. This could be the case of computer sciences, that tend to occupy important positions or, on the other hand, the Environmental Sciences. This preoccupation of the environment that surrounds us has arisen, doubtlessly, and we are taking conscience of the situation and the great deterioration and danger of our subsistence because of the interaction with all the nature.

Environmental Sciences are characterized being eminently interdisciplinary. They are studies of synthesis of other sciences of more analytical character. In general, all environmental sciences, or all those matters that are based on the study of the reality that surrounds us, necessarily need to have an interdisciplinary character.

Engineering curricula do not contemplate environmental sciences studies; they are not integrated in other subjects in where their thematic involve studies of processes that deteriorate the environment. Thus for example, the student is able to design a steam generator to produce energy, using a fuel, but he never is taught to control the emissions to the atmosphere.

In the international meeting on environment education in the school study plans, taken place in Paris in 1970, and carried out by the education commission of the international union for the conservation of the nature (IUCN), they agreed to propose and extend the definition of environmental education as: "the process that consists on to recognize values and acclaim concepts with the object of increasing the necessary aptitudes and attitudes to understand and appreciate interrelations among men, his culture and his biophysical medium." The environmental education also involves the practice of taking decisions and in the own elaboration of a behavior code referring to the questions related with the environment's quality.

The Finland national commission for UNESCO, in 1974, elaborated another definition: "The environmental education is a way to reach the objectives of the medium's protection. The environmental education is not a science's branch or a separated study matter; it should be carried out in agreement with the principle of a permanent integral education."

The environmental education is characterized in a general way by two aspects:

1. Its interdisciplinary character.

2. Its orientation over the resolution of the environmental problems.

The ecology is a synthesis science of other several ones that are more analytical. In general, all the environmental sciences or all matters that are based in a wide study of the reality that surrounds us must necessarily have an interdisciplinary character.

The current teaching, which is based in a reality's information, divided in several topics, treats physics, chemistry, mathematics, etc., as if they were subjects with any relationship and easily separable. Keeping in mind this pedagogical current challenge, that tries to reach to the teaching globalization, the environmental education could be a fundamental element to get it, due to that interdisciplinary character that it has.

The pedagogic methodology.

The environment sciences are typically experimental sciences. This consideration, being known by the generality of teaching professionals, it's not usually put into practice.

The experimental sciences base their study in the scientific method application, therefore, to look for an appropriate methodology for the teaching of the environment, implies to follow norms adapted to the deductive character of the scientific method.

The environment education has some characteristics that make it to have to use varied methods according to the premises that are obtained for each topic or person to whom it is directed. We may say that the environment topics should be treated in an experimental, active and analytic way. For example, if a group of engineering students want to study certain ecosystem, the experimental method, active and analytic, would include:

- Under the professor's coordination, the students would choose the ecosystem, gathering in the specific place the samples and data.
- The students in the laboratory would analyze the samples.
- They would elaborate a report with the pertinent conclusions, analyzing why those characteristics are given in this ecosystem.

This methodology will create in the student a responsible spirit over the study object. Hence, the teaching of the environmental sciences should be based in the observation and in the experimental work, supplemented with the theoretical study of the different disciplines bases.

The desvinculation between the university classroom and the knowledge applications in engineering is due to:

- Rigidity of schedules.
- Traditional evaluation procedures.
- An excessive importance to the theoretical classes.
- Professor's insufficient preparation for an experimental teaching.
- An excessive number of students in classrooms.
- Lack of material for the laboratories and field practices.

According to this, results very important the creation of:

1. Programs of environmental teaching in the engineering study programs, in all the levels.
2. The creation of university departments in environmental sciences.

According to this analysis, we propose to include in each subject in where engineering processes is studied, the subjects corresponding to the contamination which they generate, as they can be emissions to the atmosphere, generation of solid, toxic and dangerous remainders, contaminated water, etc., studying its control and treatment, so that the environmental subjects will not be taught in separated courses but that they would be integrated in the subjects programs, so that the student would learn the environmental control like part of the process and not it approach like something additional or optative.

Pilot experiences have been developed in subjects of the Agricultural Engineering curriculum, obtaining good results because a student greater motivation has been observed, which has brought a greater efficiency in the subjects, in courses of mathematics have even considered equations differentials generated by chemical reactions of formation of atmospheric polluting agents, obtaining a greater interest on the part of the students. In a design of random blocks to compare a traditional group with our pilot groups, we found a significant difference ($P<0.05$) in the qualifications obtained and in the approved students percentage, being these better indices in the case of the pilot groups.

The universities, which are attempting in this moments in our country the new orientations towards the future, should create a specialty in environmental sciences to form professionals able to attack the tasks and challenges presented by the development of the urban nucleus and their incidence over the environment.

Due to the nature's characteristics and the ecology, it is evident that all the actions taken to protect and to conserve our environment must have a universal value. Nature doesn't understand the artificial frontiers made by men, therefore, if we want to get an environment free of aggressions, we must take actions applicable in all the nations. All those activities that promote actions at an international level in the environmental education will have two fundamental consequences: the approaching of all the nations and the assuring that our environment will be able to enjoy during many millennia the harmony and balance that it had in the past.

Considering environmental sciences studies in the curricula, will assure us to have conscientious professionals and able to develop in sustainable form Engineering's projects.

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