The Teaching of Environmental Sciences in Secondary Education, High School and University to Fight Against Climate Change

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Abstract	The environmental contents in Compulsory Secondary Education (ESO) and Baccalaureate are reviewed, being scarce and not adapted to the environmental reality. Faced with the profound climatic changes that have occurred and that increase day by day, causing natural disasters, in terms of loss of life, and in terms of great economic losses. For this reason, it is essential to incorporate new content in the teaching of Natural Sciences (Biology, Geology, Physics, Chemistry) in the different teachings, both university and non-university.

Keywords (separated by '-')	Pollution - Green city - Environment - Mitigation - CO_2

The Teaching of Environmental Sciences in Secondary Education, High School and University to Fight Against Climate Change

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Abstract. The environmental contents in Compulsory Secondary Education (ESO) and Baccalaureate are reviewed, being scarce and not adapted to the environmental reality. Faced with the profound climatic changes that have occurred and that increase day by day, causing natural disasters, in terms of loss of life, and in terms of great economic losses. For this reason, it is essential to incorporate new content in the teaching of Natural Sciences (Biology, Geology, Physics, Chemistry) in the different teachings, both university and non-university.

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1 Introduction

The contents taught in this subject are aimed at students acquiring the foundations of scientific culture, with special emphasis on the unity of the phenomena that structure the natural environment, on the laws that govern them and on the mathematical expression of these laws, thus obtaining a rational and global vision of our environment with which they can face current problems related to life, health, the environment and technological applications, with special emphasis on climate change.

In the Secondary Education, Baccalaureate and University stages, among others, the physical-chemical, biological-geological aspects of nature are addressed.

In today's society, science is an indispensable instrument for understanding the world around us and its transformations, as well as for developing responsible attitudes about aspects related to natural resources and the environment.

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Knowledge about natural sciences must be consolidated and expanded during secondary and high school, by incorporating practical activities, and adapting the contents to the social and environmental reality of the historical moment, so it is essential to include in the contents various environmental aspects, such as land [1–4], water [5–7], fire [8–10], climate change [11–13], green cities [14–17]. This will allow to adopt critical attitudes based on knowledge to analyze, individually or in groups, scientific and technological environmental issues, which allow us to face the risks of today's society in aspects related to the environment. Understand the importance of using the knowledge of the natural sciences to satisfy human needs and participate in the necessary decision-making around local and global problems that we face. Know and value the interactions of science and technology with society and the environment, with particular attention to the problems that humanity faces today and the need to search and apply solutions, subject to the precautionary principle, to moving towards a sustainable future. Recognize the tentative and creative nature of the natural sciences, as well as their contributions to human thought throughout history, appreciating the great debates overcoming dogmatisms and the scientific revolutions that have marked the cultural evolution of humanity and its conditions of life [18, 19].

Consequently, it is necessary to establish as fundamental objectives in the teaching of Natural Sciences [20–22]: 1) understand and use the strategies and basic concepts of the natural sciences to interpret natural phenomena, as well as to analyze and assess the repercussions of techno-scientific developments and their applications; 2) apply, in problem solving, strategies consistent with the procedures of science, such as the discussion of the interest of the problems posed, the formulation of hypotheses, the elaboration of resolution strategies and experimental designs, the analysis of results the consideration of applications and repercussions of the study carried out and the search for global coherence; 3) understand and express messages with scientific content using oral and written language properly, interpret diagrams, graphs, tables and elementary mathematical expressions, as well as communicate arguments and explanations in the field of science to others; 4) obtain information on scientific topics, using different sources, including information and communication technologies, and use them, evaluating their content, to support and guide work on scientific topics. All this in order for the student to acquire certain capacities, which allow them to acquire specific competences to combat climate change [23–26]. As would be the 1) knowledge and interaction with the physical world; 2) mathematical competence, since it is necessary to use mathematical language to quantify natural phenomena, analyze causes and consequences, and express data and ideas about nature; 3) competence in the treatment of information and communication, as well as the acquisition of digital competence; 4) social and civic competence, the contribution of Natural Sciences to this competence is linked to the role of science in the preparation of democratic, participatory and active citizens in decision-making, in addition, it contributes to a better understanding of issues that are important to understand the evolution of society in past times and analyze current society; 5) competence on linguistic communication, in this case this competence is achieved through the construction of scientific discourse, aimed at arguing or making explicit their relationships taking care of the precision of the terms used, properly chaining ideas or in verbal

expression and acquisition of the specific terminology on living beings, objects and natural phenomena; 6) it is necessary for the student to learn the contents associated with the way of constructing and transmitting scientific knowledge constitute an opportunity for the development of this competence. Lifelong learning, in the case of knowledge of nature, is produced by the incorporation of information that comes sometimes from one's own experience and on other occasions from written or audiovisual media. Finally, personal initiative is required, placing special emphasis on the formation of a critical spirit, capable of questioning dogmas and challenging prejudices, allowing to contribute to the development of autonomy and personal initiative. In this sense, it is important to point out the role of science as an enhancer of the critical and participatory spirit in the search for solutions.

The objective of this study is to highlight the importance of adapting the environmental reality in teaching, for which an adaptation of the contents of Natural Sciences is proposed, and an increase in practical learning over theoretical.

2 Methodology

Learning is conceived as a change in conceptual schemes on the part of the learner. It is based, therefore, from the acceptance that the students have previous schemes of interpretation of reality.

The organization of the contents takes into account the very nature of science as a constructive activity and in permanent revision. Construction of knowledge is favored through active learning, so that the student cannot be a mere passive receiver [26].

In this way, what is learned depends fundamentally on what has already been learned (previous knowledge), and on the other hand, the learner constructs the meaning of what has been learned from his own experience; that is, from their activity with the learning content and its application to family situations.

A work process is put into practice, which allows the use of the didactic elements that make up the different learning situations. Therefore, it is about applying different methods: a) inductive: starting from the particular and close to the student, to finish in the general, through increasingly complex conceptualizations, such as the knowledge of some plant species; b) deductive: starting from the general, to conclude on the particular, in the environment close to the student, for this, satellite images are used on the landscape; c) inquiry: through the application of the scientific method; d) active: based on the performance of activities by the student, laboratory activities; e) explanatory: based on explanation strategies; f) participatory: inviting debate; g) mixed: tending to unite in the same didactic unit the practice of more than one of the previous methods. When using these methods, it should be taken into account that adolescence is a stage in which important and great changes occur, not only in the individual himself and in his way of interacting with his peers and other people, but also in the acquisition of new ways of thinking.

As a general strategy, the motivation, curiosity and interest of the student must be aroused, through the relevance and presentation of the information.

To achieve the objectives stated above, the teacher must pay attention to students with specific educational needs, being multiculturalism in the classroom an adaptive teaching model [27].

The teaching of Natural Sciences requires a development of the ability to observe and interpret reality, which subsequently enables the student to make proposals for environmental improvement [28–32].

Teaching that is necessary as a result of the increase in CO2 due to climate change, which is due to an excessive use of fossil fuels, making it necessary for governments to promote renewable energies.

Global warming is now an unequivocal fact, as reflected in the fourth report of the Intergovernmental Panel on climate change. The third evaluation report revealed that there had been an increase in temperature of approximately 0.6 ºC [between 0.4ºC and 0.8ºC], affecting physical and biological systems in different parts of the globe; The linear trend at 100 years is estimated at 0.74 °C [between 0.56 °C and 0.92 °C], as opposed to 0.6ºC in the third report.

The greenhouse effect caused by global warming can and should be mitigated by applying sustainable development, which is achieved through bioclimatic agricultural and forest management, and using herbaceous plant covers (Stellarietea mediae) in agriculture.

3 Results and Discussion

The conceptual contents of Environmental Sciences are established in the common teaching curriculum, where a connection is established between Physics and Chemistry and Biology and Geology, with respect to the work and scientific method, as well as an assessment of the contributions of the natural sciences to development of humanity. These contents were established in Spain in 2007, which should force a revision of contents, which better adapt to the current environmental reality [34]. The contamination of land and water by the indiscriminate use of chemical products, has caused a profound change in cultivation techniques, this being the cause of the loss of plant species, with a decrease in the soil seed bank. The same phenomenon occurs in most of the Mediterranean areas treated with herbicides; the increase in CO_2 as a result of the excessive use of fossil fuels, forest fires, has led to climate change on the planet. Change that is being accelerated, since CO_2 continues to increase at the same time that the vegetation cover decreases, which could mitigate said change, by acting as a CO_2 sink [35–39].

In the case of the majority crops, it is evident that until a few years ago the cultivation has been something traditional, with life models acquired throughout history, so that the crops have always been somewhat plural, insofar as it has been given a heterogeneity and not a monoculture that has been reached in certain cases, which has put the territories in the hands of speculators.

Management models were acquired that were not standard models, but in each territory there was a specific model, therefore phenomena such as pruning, tillage, type of plantation, obtaining agricultural product, was typical of each town / region, all of this it is lost in an inordinate desire to increase production, and it moves to a sustained agriculture in which there is a loss of biodiversity and stability of the agroecosystem.

When we talk about sustainability, we are talking about the ability to endure over time without detriment to natural capital (soil, diversity, fauna, etc.) and culture, such as types of management, which enable production and renewal over time. From the different

definitions given for "Sustainable Agriculture", we can choose that of the American Agronomy Society: "sustainable agriculture is one that in the long term improves the quality of the environment and the basic resources on which it depends, provides the necessary food and fiber for humanity, it is economically viable and improves the quality of life of the farmer and of society as a whole". In reality what the farmer must pursue is to abandon the criteria of maximum production per hectare, improving the productivity of the farm, through better management of productive factors.

Although for some authors traditional and sustainable agriculture is the same thing, it should not be treated in this sense, since traditional agriculture involves a type of knowledge acquired over millennia, and very empirically contrasted, so it cannot be substituted by current organic farming practices, since this represents a very simplistic model. It can be admitted that the traditional forms of management constitute coherent eco-compatible systems, while the current sustainable cultivation is not or does not follow 100% the traditional model.

The consequence of practicing sustained agriculture causes profound transformations, which in many cases causes loss of biodiversity, which is taking place in a gigantic way. The loss of floristic biodiversity brings with it fauna losses, biological control mechanisms are affected and an insect-plague explosion arises. This loss of floristic diversity is due, among other causes, to inappropriate tillage techniques, loss of plant cover, lack of organic fertilizers, use of rollers (soil compaction), indiscriminate use of herbicides and as a consequence, increased erosion and loss of soil [5, 40]. For this reason, it is convenient to use non-aggressive agricultural practices with the environment, among which would be traditional cultivation and sustainable cultivation, at least for marginal areas. For non-marginal high production areas, it is convenient to mix both techniques, that is, planning the cultivation on an ecological / botanical basis [41].

At this time a non-aggressive cultivation is possible, since there are advanced botanical investigations, both bioclimatic and edaphic [42], through which we can know the nutritional status of the soil, which allows us to use appropriate doses of fertilizer, avoiding the excess, which only affects the contamination of aquifers and economic losses for the farmer [43–45].

In the last 50 years a new agriculture has been introduced, which with full economic and social acceptance has survived to this day. A consequence of this has been the excessive use of pesticides, herbicides and phytosanitary products, causing a great environmental impact, with the consequent damage to the population. A crop is unproductive when the cost of production is equal to or greater than the income received by the farmer. In said expense is included the entire set of activities necessary for production and the environmental cost, which in most cases is not quantifiable. Considering as unproductive that whose cost is higher than the income it generates, even those apparently productive crops with modern technology should be considered unproductive, if the environmental cost is excessively high, and all those situations in which the cultivation causes irreversible losses of a certain resource. However, those cases of "contamination" in which the system itself is capable of self-regeneration can be allowed. Therefore, the expression "the polluter pays" is not correct, since resources can be lost that cannot be priced, as they are high ecological-natural values. Furthermore, cultivation is not valid at the expense of irreversible losses of soil, biodiversity, contamination of water and land, the

latter being the ones that must be considered essential to carry out the implantation of a crop. All the situations contemplated within any of the previous cases, must pass to agrarian reform of a technical nature. Carrying out agricultural planning in which the crop is maintained respecting the above principles, is productive and can even increase said production, it is also possible that said production is of quality, since quantity and quality are compatible, this implies having taking into account the bioclimatic aspects of the territory [47].

It can be affirmed that living plant covers are therefore beneficial, not only to prevent erosion and maintain productivity, but to mitigate climate change, by acting as a sink for CO_2. On the other hand, the use of plant covers is not such a big deal novel, since they were already used by the Romans in the cultivation of vineyards, having been studied and used since the beginning of the 20th century.

The study on the teaching of natural sciences in the classroom, in relation to climate change, increase in CO2, pollution phenomena, forest fires, anthropic action in general, reveals the need for more practical than theoretical learning, which will imply that the curricula of the various countries must adapt to the new world reality.

4 Conclusions

As a consequence of the analysis of the current environmental problems and the proposal of new contents in the teaching of ESO and Baccalaureate, basic competences are acquired, which will allow decision-making, regarding what to do to provoke sustainable development and avoid that being given the climate change. To achieve this, it is necessary that teaching be given in accordance with the environmental needs of the moment. Therefore, the teacher must not only teach, but also motivate learning in this field, making the student aware of the importance of this learning, so that it in turn radiates to society. Teaching that must be structured with content adapted to the environmental reality, since at this time they are relatively scarce.

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Chapter 162

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