



## **The Concept of Energy from a Sustainable and Responsible Point of View in the High School Curriculum in Spain.**

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### **Abstract**

*In this work an exploratory analysis of the treatment of the concept of Energy from the point of view of sustainable development in the current curriculum of secondary education and baccalaureate in Spain is carried out. The documents analyzed were Spanish Royal Decree 1105/2014, which regulates nationwide the basic aspects of the curriculum of Secondary Education and Baccalaureate, and Decree 98/2016, establishing the management and curriculum for the Autonomous Community of Extremadura. The purpose of the work has been to analyze from a lexicographic perspective the concept of energy and analyze the subjects in which it is taught in the 12-18 years old range. A system of categories has been established to study the approach of the concept of sustainable and responsible energy, with the purpose of analyzing what curricular elements must be added to the curriculum to complete the school and scientific formation on this concept, from the point of view of responsibility and awareness. The design of the research has been qualitative with a descriptive statistical treatment of the data obtained. In order to explain the responsible and sustainable approach to the energy implicit in the regulations analyzed, all references related to the concept of development of efficiency, sustainability and related elements have been taken into account. Based on the analysis of all the sentences, different categories were established to classify the references to the field of responsible energy included in the regulations analyzed: Energy Sources, Consumption / Use, Technology, Awareness and Ethics and Energy Efficiency. The results show that the word energy appears linked to some type of responsibility in six different forms, used as the indicators of the study. For each of these indicators a comprehensive descriptive analysis has been performed. In general terms, the regulation gives a high relevance to the concept from the point of view of technological progress to contribute to social development, efficiency, sustainability and a correct use of energy, as well as a wide endorsement and sponsorship of renewable energies.*

### **1. Introduction**

Science and technology are two fundamental pillars in today's society. International institutions have produced reports [1, 2] highlighting the importance of giving current society a minimum level of scientific and technological training. In this sense, education plays a very important role, and it is necessary to promote a complete scientific and technological literacy from the first stages of school. Some authors [3] relate the concept of scientific literacy to the elements needed to educate citizens, supporting their development and enabling them to solve problems related to the science and technology of today's world. Likewise, the view of science from a scientific, technological and social (STS) perspective has led to a renewing movement in the school curriculum oriented towards this approach. This STS trend is aimed at improving the neutrality attributed to science and highlighting its revitalizing role in the development of society [4]. The construction of scientific literacy poses new challenges in the teaching and learning of experimental sciences. The evolution of educational reforms has considered science as a compulsory subject in every curriculum. However, the design of the curriculum has been reorganized according to national and European guidelines. Thus, to acquire scientific competences, subjects of scientific content are included from primary until secondary education, where they go from being compulsory to optional.

In this work, we focus on one of the scientific concepts of special social relevance, the concept of Energy, and an analysis of its treatment in the current education is carried out. Specifically, from the point of view of environmental education, the concept of energy is related to the concept of sustainable development due to the environmental implications of its correct management in its different phases, from generation through transport, to distribution and consumption. The teaching of energy aims to make students develop awareness and, above all, an ability to evaluate the short-term and long-term consequences of energy consumption and development in the world where we live [5].

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This paper examines how and in what way this concept appears in Spanish legislation, as well as the subjects in which it is taught and how it is promoted.

## 2. Methodology

The general objective of the study was to analyze the reference to the concept of energy from the point of view of sustainable development in the regulation that standardizes compulsory secondary education in Spain both at national and regional level [6, 7].

The research design carried out in this study has been qualitative with descriptive analysis. In order to explain the responsible and sustainable approach to energy implicit in the regulations governing secondary education in Spain, all references to the concept of energy have been analyzed. Of these, only those related to the development of efficiency, sustainability and associated elements have been taken into account. From each text with references to the concept of energy, we have considered all those sentences with a logical meaning that reflect a characterization of the concept. From the analysis of the sentences found, several categories were established, which allowed to classify the references to the field of responsible energy included in the normative.

## 3. Results

In this section, some of the results obtained in the descriptive analysis carried out are shown by way of example. Specifically, in the Royal Decree that regulates the school curriculum in Spain, the word energy appears in six different expressions, which have been used as the indicators of the study. Indicator 1: *Energy Sources*; Indicator 2: *Use and Consumption of Energy*; Indicator 3: *Renewable and Non-Renewable Energy*; Indicator 4: *Social Impact of Energy*; Indicator 5: *Energy Efficiency and Sustainability*. Figure 1 shows the total number of references according to the different indicators, both in the current national and regional regulations. The references to the concept of energy appear in 53 occasions in [6]. The same forms and expressions are repeated in [7], appearing on 63 occasions.

|                               | I1     | I2     | I3     | I4    | I5     | Total number of references |
|-------------------------------|--------|--------|--------|-------|--------|----------------------------|
| <b>Royal Decree 1105/2014</b> | n = 18 | n = 6  | n = 4  | n = 3 | n = 22 | n = 53                     |
| <b>Decree 98/2016</b>         | n = 20 | n = 9  | n = 10 | n = 3 | n = 21 | n = 63                     |
| <b>Total</b>                  | n = 38 | n = 15 | n = 14 | n = 6 | n = 43 | n = 116                    |

Fig. 1. Number of times the reference to the energy concept appears.

Figure 2 indicates the percentage with which the sum of the references obtained contributes. The percentages obtained are similar in some of the indicators comparing national and regional regulations. Indicator 1 and 5 have the highest impact in both regulations. Based on the analysis carried out, it should be noted that, on the total of indicators evaluated, I5 is the most represented. With a slightly lower percentage is I1. Indicators I2 and I3 present similar percentages. The indicator with the least repercussion is I4.

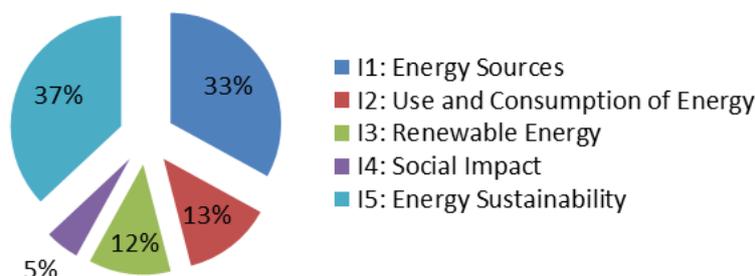


Fig. 2 Percentage of the different indicators



To determine which energy concept is studied in the normative that regulates the Secondary Education and Bacallaureate curriculum, all energy statements appearing in the different subjects studied have been selected and analyzed.

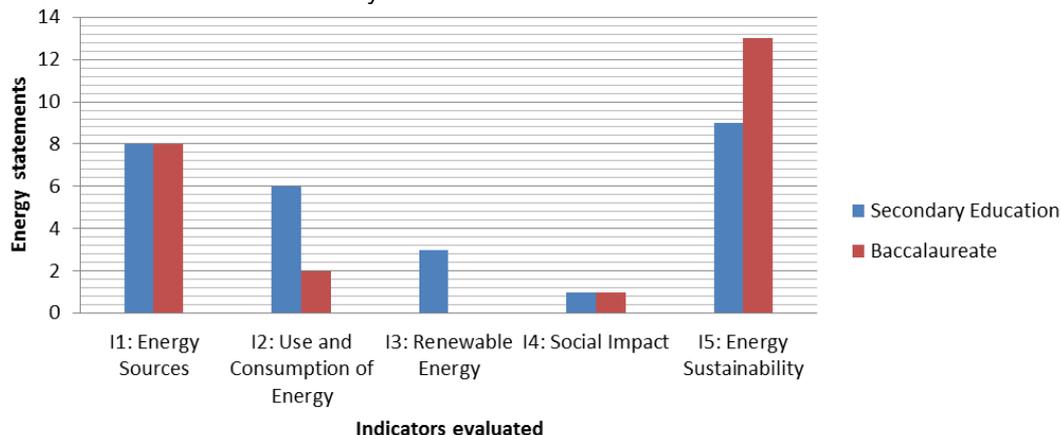


Fig. 3. Number of sentences referring to the concept of energy in the curriculum.

Indicator 1: Three of the statements belonging to Secondary refer to renewable and non-renewable energy from different points of view such as advantages, disadvantages, comparative between the two, environmental aspects, etc. One of the sentences literally alludes to the sources of energy, another refers to the concept of generation, transport and storage, and the rest refer to the daily use of energy of the human being. In Bacallaureate, the statements refer to the relationship that exists with the industrial world, its location within Spain, existing types, new alternative sources, its transformations, and the classification of energy systems

Indicator 2: The eight statements analyzed dealt with the consumption and the correct or incorrect use of energy. Two of the references try to critically assess and raise awareness about the impact of rational use of energy. Two other sentences refer to the use of nuclear energy from a critical assessment point of view, as well as factors for and against it. The two remaining sentences specify areas of worldwide consumption and information about them. In the bacallaureate stage reference is made to the use of new and classical energies as well as the use of energy for the manufacture of nuclear weapons.

Indicator 3: Three statements analyzed address renewable and non-renewable energy, all linked to compulsory education. In one of the statements reference is made to their identification, in another to the searches of new non-polluting energy sources to improve our society. However, this statement has not been introduced in the first indicator because it does not directly address the concept of energy source, but rather treats renewable energy as a binding link to improvement in our society. The last of the sentences refers to the fuel cell as the new energy of the future.

Indicator 4: There are two statements, of recognition and valuation, related to social and environmental impact.

Indicator 5: Twenty-two statements that address sustainability, efficiency and development in the energy field are analyzed. Of the nine statements in Secondary Education, two allude to sustainable development, three are aimed at promoting energy savings in housing and one to experimentation through basic circuits and the search for savings measures. Finally, there is a statement that proposes measures focused on energy saving from the individual and collective point of view and another to the importance of awareness campaigns to seek of the correct use of energy resources. In the Bacallaureate stage the statements analyze the importance of this field in society, the sustainable utilization of energy resources as well as their correct management from the environmental point of view, proposals to reduce consumption, elaboration of reduction plans, etc.

#### 4. Conclusions

Based on the results obtained, we consider that the regulation that standardizes school education in Spain treats the concept of energy from a holistic point of view in a depth and mandatory way. This is relevant in the society in which we live, a society with a high degree of scientific and technological literacy, where many human activities have a direct impact on the health of our Planet, such as the generation and consumption of energy. On the other hand, the legislation analyzed sponsored the idea of energy in a model oriented to balance economic growth. Specifically, it takes into account



certain environmental considerations, based on the premise that civilization is suffering an environmental crisis due to the massive consumption of resources, pollution and loss of diversity. This vision can be perceived in the development and responsibility reflected in the curriculum, since it exhibits the social and environmental needs in this field. Finally, it is necessary to emphasize that the inclusion of environmental education and awareness in society in the different stages of education implies a process of reflection and appreciation of environmental processes. Didactic strategies and methodological approaches are necessary to enable the structuring of critical, creative, reflective thinking. In this way, the students will have the right tools to be able to face STS problems. For this reason, the analysis carried out in this study allows us to affirm that these new didactic strategies around this concept are implicit in the regulations that normalize education in Spain.

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