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Water from the Perspective of Education for Sustainable Development: An Exploratory Study in the Spanish Secondary Education Curriculum

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Abstract: Current educational curricula in Spain contain few references to sustainability topics, so there is insufficient coverage of these issues in the classroom. Notably, there is a lack of reference to the concept of water from a sustainable perspective. The key aim of this study was to analyze the presence of the concept of water in the curriculum that regulates secondary education in Spain using a previously established system of categories. An exploratory and descriptive research methodology was followed, in which we carried out a qualitative lexicographical analysis of the concept of water in the Spanish secondary education curriculum. An analysis of the cognitive demand required of students to learn about water, according to Bloom's taxonomy, was also conducted. The results show that the concept of water appears moderately in the curriculum focusing on some aspects of Sustainable Development. Likewise, the analysis of the cognitive demand required of students for learning about water reveals that lower levels of knowledge and comprehension predominate based on Bloom's taxonomy. We consider that teaching water from a sustainable perspective can generate in students awareness and values about nature and the environment, knowledge that contributes to sensible use of water and involvement for sustainable development.

Keywords: water; education for sustainable development; secondary education; curriculum

1. Introduction

Concern for the environment and the conservation of natural resources is gradually spreading as a shared endeavor [1–4]. This is because more and more resources are being consumed, more waste is being produced, and the Earth's human population is growing at an exponential rate [5]. Soon, it will not be possible to satisfy the needs we have created with the current growth model based primarily on consumption [6]. However, studies [7] show that the economic growth that has occurred in recent years has led to a decrease in environmental commitment since a large part of society is not willing to give up certain comforts. Global challenges confront humanity with the need to achieve sustainability in a world with limited natural resources. The availability of fossil fuels, raw materials, drinking water, clean air and even the climate balance itself are now at a critical point, and even food is becoming alarmingly scarce in the poorest areas because of slower growth [8]. Given the current global environmental crisis, it is necessary to expect the impact that our actions have on social and natural systems to balance the economic projects of our society with the ecological requirements of the planet [9].

1.1. Water, an Important Natural Resource

Of the environmental challenges listed above, water is and will be one of the greatest concerns of society [10]. Water is, after air, the most essential element for life and can be considered a key element from the perspective of sustainability. All living beings, regardless of their ecological niche, require at least a minimum amount of water to live. However, only a small percentage of the world's water is easily accessible for human consumption, and a large part of this is contaminated [10]. Humans have changed the natural landscapes around rivers and wetlands to the point that their biodiversity is at risk and the goods and services that freshwater ecosystems provide are being compromised [11]. Fortunately, some progress has been made in the last decade and over 90% of the world's population has access to better-quality drinking water sources [12].

The water sector, besides being a sector in its own right, is at the same time part of the environment, agriculture, energy, health, infrastructure and many other sectors [13]. Water should provide economic well-being to people without compromising social equity or environmental sustainability [14]. Integrated management and policy development are essential to promote sustainable development in water sector operations [15]. The need for a significant change in water management has been advocated by several voices in recent years [16–19]. In particular, the number of people supported by freshwater ecosystems needs to be quantified so we can improve the collective benefit for all populations [20]. Most of the water indicators used to date have focused on analyzing the locations from which water is withdrawn to meet human needs and carry out various activities [21]. Other indices have focused on measuring different aspects of the state of freshwater ecosystems and their importance to humans, including the Water Poverty Index [22], America's Great Watershed Report Card [23], or The State of the World's Rivers [24].

1.2. Sustainable Development and Education for Sustainability

To transform the daily behavior of individuals and communities, it is necessary to raise awareness of the global and complex nature of the problems arising from the environment and to promote solidarity. These problems are related to the growing need to reconcile and bring together social, economic and ecological goals [25]. It is necessary to consider the situation of natural resource use in relation to the world's population and environmental degradation and, based on these considerations, to make concrete proposals. As a result, we may use one of the most used concepts when regulating any matter related to human activity and its potential impact on the surrounding environment: sustainable development [26,27]. The most frequent definition of sustainable development is that proposed by the United Nations World Commission on Environment and Development, also known as the Bruntland Commission. In its report to the United Nations General Assembly, entitled *Our Common Future* [26], the Bruntland Commission defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Along these lines, to achieve a change in the attitudes and behaviors of citizens, it is necessary for this to originate from the school [2,28–30]. Hence, education for sustainability, a paradigm that empowers learners to make informed decisions and take responsible action for the integrity of the environment and the viability of the economy [31]. UNESCO, in its "ESD Lens" document [28], provides tools to start the transition to sustainability in the classroom that can be adapted to different educational contexts and to the specific needs of countries in terms of policy and practice. It is not prescriptive but provides guidance and starting points for reviewing educational policy and practice in ESD.

Education is key, not only to understand the relationships between natural and social systems but also to achieve a clear perception of the importance of sociocultural factors in the origin of environmental problems [32]. In recent decades, the promotion of environmentally friendly behavior has not only increased through the media but also through formal and informal sustainability education programs [33]. For example, in some countries such as Norway, education for sustainability is reflected in national curriculum documents, starting in kindergarten and continuing throughout schooling. Other Scandinavian countries are also recognized as leading nations with commitments to education

for sustainability from early childhood. New Zealand has established the "Enviro-kindy" movement that focuses on children before they start primary school [34]. In Asia, there is the South Korean "Green Childhood Education" movement [35]. Likewise, international institutions such as the United Nations have proposed the Sustainable Development Goals (SDGs) as an international agenda that will guide development policies into 2030, so that the countries of the world continue their efforts to achieve sustainability [4,12,31]. These UN Sustainable Development Goals include an education sector goal, SDG 4 "Quality Education", which focuses on the acquisition by students of the knowledge and skills needed to promote sustainable development [36]. This agenda also considers water in its SDG 6 "Clean Water and Sanitation" [12], so the state of water has become a goal and a challenge to be faced in the coming years [37].

1.3. Teaching and Learning about Water

Concerning the training of students about water (a resource necessary for life and social progress) [38], many students from secondary school and baccalaureate have incorrect ideas about the location and availability of freshwater on the planet [5]. Even though water is a recurrent topic during compulsory secondary education, students do not know well the origin and destination of the water they consume. Students do not mention the existence of drinking water treatments prior to the faucets or the purification processes. Other studies [39–41] confirmed that people who carried out practical experiences aimed at promoting water-saving habits showed a higher level of knowledge about water conservation. The students followed the recommended behavior in this practice more often than the students in the control group. The flipped classroom method improves the students' learning dimensions of water literacy [37]. In this sense, it is essential to carry out actions that lead to reflection on the origin of this natural resource [42], the actions that influence it and the acquisition of skills that allow for the development of solutions to the scarcity of this asset [43].

Besides training students in areas related to sustainability, it is also necessary to promote teacher training in this area [44,45]. A study comparing the attitudes and beliefs about science, technology and society (STS) of practicing teachers at different educational levels showed a lack of knowledge among them [46]. Teachers, mainly of science subjects, consider issues related to environmental conservation to be important [5]. However, teachers find these issues difficult. They have a tendency to carry out environmental education by developing strategies oriented towards providing information, even though they claim to be doing environmental education [47,48]. In this line, there is a lack of knowledge by future teachers on issues related to sustainable development, in legislative and theoretical aspects [44]. Teachers claim to have an adequate level of knowledge on some water-related issues but declare that the educational curriculum does not give priority to this resource [5,49–53]. They generally show responsible behavior towards the environment as well [36]. However, many educators find it difficult to complete coursework on time, making it difficult to emphasize sustainability issues [5]. Current primary school teachers do not carry out inquiries that promote student learning about the environment, because they lack confidence in their ability to do so [54]. Courses in educational methods and professional development can support teacher training in teaching environmental issues [55].

1.4. How Water Is Handled in the Educational Curricula

The need arises for the educational community to address competencies for sustainable development as a basis for more effective curriculum design and pedagogy [56]. Educational institutions should ensure positive models of environmental behavior by working on the contents of the curriculum [57,58]. Didactic interventions on sustainability have been shown to have a positive impact on subsequent decision-making [59,60]. It is important to urge the competent authorities to carry out reforms in the curricula of all the formative stages, focusing in specific subjects. This way the interactions generated by the processes of human development with the environment and their consequences can be explored and understood [61]. However, for the integration of education for sustainable development into the classroom to be effective, experts in the field should support the

work of the educational commissions responsible for organizing the curriculum. This would ensure that the integration of education for sustainability is a robust process rather than a mere option for teachers [62]. Authors such as [63] suggest that we must go beyond the organization of content on sustainable development in the curriculum. The different educational stages must also be considered, so that the basic knowledge gained during primary education is complemented in secondary education. In this way, curricula for all stages of education for sustainability are unified. Some authors add that the organization of curricula should not only be aimed at promoting sustainable attitudes among young people. They should also offer students the possibility of specializing in specific sustainability issues in more advanced courses [64]. To effectively incorporate sustainable development into the study plans, it is necessary to evaluate what already exists in the different courses and curricula [65]. In this regard, some research examined the concept of sustainable development in the curriculum of public schools in several countries. For example, the curriculum of Iceland at the different educational levels offers some aspects for sustainable development, although not very evidently [66]. There have also been studies on the impact of ESD on the English national curriculum in primary schools [67]. These authors conclude that the curriculum reviewed has placed a strong emphasis on environmental education for years. However, the research points out that the educational curriculum analyzed may generate an inadequate image to teachers about what education for sustainability really entails. In addition, many Chinese and American educational institutions designate the concept of sustainability to educational plans at the graduate level and offer it as an optional rather than a mandatory course [68]. In Ghana [69], educational plans continue to prioritize economic growth and modernization rather than ecological aspirations. Other studies [70] analyzed what new content on the concept of water can be taught in formal education. The author proposes an integrated education in the STS framework.

1.5. Previous Works and Justification

We used as a starting point our own previous studies in which references to key sustainability concepts such as waste [71] and energy [72] in the curriculum of Compulsory Secondary Education (CSE) and Baccalaureate in Spain were analyzed. We also based on the results of another study of our own where we analyzed the key concepts of water, energy and waste in the primary education curriculum [73].

With primary education, the study [73] carries out a lexicographical analysis of key sustainable concepts (water, energy and waste) in the official curriculum to check whether these concepts are studied from a sustainable perspective. The results of the study reveal that these concepts are not generally addressed from a sustainable development perspective, with the concept of waste being the least defined. This shows that there is a need to carry out actions in the primary classroom that promote training in sustainability among the younger population.

On the concept of waste in secondary education, it is concluded that it should be dealt with in greater depth in the regulations governing secondary education in Spain [71]. As this is a vitally important issue from a social and environmental perspective, dealing with it in the classroom could generate appropriate management actions in the students.

Regarding energy in secondary education, Spanish educational legislation includes aspects related to sustainability such as renewable energy sources, the valuation of the role of energy in human well-being or the environmental consequences of human energy consumption. The legislation therefore considers the teaching of the concept of energy to be relevant from the point of view of sustainable development [72].

Building on these previous studies, this research explores the concept of water in Royal Decree 1105/2014 [74]. This document of obligatory compliance aims to establish the basic curriculum of Compulsory Secondary Education and the Baccalaureate in Spain.

1.6. Objectives

The general objective of this research was to analyze qualitatively the references to the concept of water in the regulations governing compulsory secondary education in Spain through Royal Decree 1105/2014 [74]. This general objective can be broken down into the following specific objectives:

- Specific Objective 1 (SO1): To establish a category system to explore how the concept of water is taught in the selected regulations [74] from a sustainable development perspective.
- Specific Objective 2 (SO2): To analyze the subjects and curricular elements in which references to the concept of water in secondary education are included.
- Specific Objective 3 (SO3): To analyze the cognitive demand required of secondary school students on the concept of water, according to Bloom's taxonomy [72,75,76].
- Specific Objective 4 (SO4): To compare the presence of the concept of water in the regulations governing Secondary Education and Baccalaureate (13–17 years) with Primary Education (6–12 years) carried out in a previous study [73].

2. Methodology

The research design was descriptive and exploratory [72], carrying out a qualitative analysis of the secondary education curriculum following a methodology like that developed in previous studies [66,71–73,77–79]. Conceptual content analysis focuses on the frequency of keywords or statements in a text [80] to produce key category counts and measures of the amounts of other variables [81]. In the research presented here, a lexicographical analysis of the concept of water in the Spanish regulations governing secondary education [74] was carried out.

All references found in the secondary school curriculum on the concept of water were qualitatively analyzed. Based on the references found, an exploration was made of the subject matter taught, the academic level and the curricular element to which it referred (whether it be a content, evaluation criterion, evaluable learning standard or introduction to the framework of the specific subject).

Likewise, a qualitative analysis was made of the cognitive demand required of students to learn about water at the two educational levels, compulsory secondary and baccalaureate.

2.1. Water Categories

To achieve Specific Objective 1 (SO1), all the statements related to the concept of water in the educational curriculum were analyzed and a category system was established to classify them. The purpose was to find whether water education was related to a sustainable perspective in secondary education. The very word *water* was taken as a reference, and statements referring to the concept of water from the point of view of sustainability. A lexicographical search of the concept or related references in the selected regulations [74] was carried out.

To establish the categories, an initial reading of the curriculum was carried out to identify the aspects of water that were covered. Then, the thematic lines of research were defined, that is, what aspects of water were to be valued within the curriculum. These lines were conceptualized, that is, terms were sought that defined each one of them. Each category represents a series of concepts related to the research process to systematize all the references found in the curriculum on the concept of water. Once the categories were established, a lexicographical search was carried out for all references to the concept of water. Considering their affinity, each one was assigned to the corresponding category. From the lexicographical analysis of all the statements found and depending on the subject addressed in that statement, four categories were established, being these:

- Category I—Water and Society (WS): This category includes those references to water related to environmental or social problems that affect our society and those that highlight the importance of showing awareness and ethics in the face of such problems.

- Category II—Technology (T): In this category, references corresponding to the contribution of technological development to water-related problems that improve human well-being are considered.
- Category III—Sustainability and Responsibility (SR): This category includes references related to sustainability and efficiency in the correct management of water and those related to the responsibility for the correct use of water.
- Category IV—Water (W): It includes those statements that refer to conceptual issues related to water, that is, those conceptual aspects related to water in the different subjects, such as chemical, physical and geographical aspects.

Other research supports the previous categories on water. It redefines the scientific contents on water that can be taught in formal education and for what purpose, committing to an integrated education and a sustainable approach within a STS context [70].

2.2. Cognitive Demand and Bloom's Taxonomy

The analysis of cognitive demand considers Bloom's taxonomy [72,75,76]. This classification is made according to the level of learning required of the students, based on the levels of knowledge, comprehension, application, analysis, synthesis and evaluation [75]. The first level, or *knowledge*, involves the memorization of information. An example of a statement of this level found in the curriculum is "To describe the properties of water and its importance for the existence of life", in the subject of Biology and Geology in the 1st and 3rd year of CSE. The second level, *comprehension*, involves the ability to conceive and interpret the meaning of facts or principles. For example, the statement "Recognizes the anomalous properties of water by relating them to the consequences they have for the preservation of life on Earth", again in Biology and Geology of the 1st and 3rd year of CSE. The third level refers to the *application* capacity, that is, the ability to use the learned knowledge in concrete or new situations. In the curriculum, we find at this level statements such as "To interpret the distribution of water on Earth, as well as the water cycle and the use that human beings make of it", in Biology and Geology of the 1st and 3rd year of CSE. The fourth level refers to the *analysis* or ability to separate a set into its parts, so that the meaning of these parts is understood in relation to the whole. An example of a statement of this level can be found again in the subject Biology and Geology of the 1st and 3rd year of CSE: "To analyze and predict the action of surface waters and to identify the most characteristic forms of erosion and deposits". The fifth level, the capacity for *synthesis*, concerns the ability to bring elements or parts together to form a new whole. A clear example of this is the statement "Outlines the phases of drinking water treatment and purification of water in a WWTP", in the subject Earth and Environmental Sciences of the 2nd year of baccalaureate. Finally, the sixth and final level, *evaluation*, concerns the ability to make value judgments for a purpose. In the curriculum, we find examples such as "To value the repercussions that water pollution has for humanity, proposing measures to avoid or diminish it" in the 2nd year of baccalaureate in the subject of Earth and Environmental Sciences. Considering the above, the intention of the study is to classify all the references found in the curriculum on the concept of water according to their level of cognitive demand.

3. Results

The results obtained after the lexicographical analysis of the concept of water in Royal Decree 1105/2014 are shown. The subjects linked to this concept, the educational levels at which it is implemented and the curricular element to which it refers are shown. If it refers to a content (CO), an evaluation criterion (EC), a learning standard (LS) or if it appears in the introduction to the subject (I). Each of the statements found is then related to the levels established in Bloom's taxonomy to analyze the cognitive demand required of secondary and baccalaureate students regarding water, the key concept of the study. A comparison of the results obtained in this study with those obtained in previous research is shown, in which the presence of the concepts of energy and waste in the same

educational curriculum was analyzed. Likewise, the presence of the concept of water in the primary curriculum [82] with that of secondary and baccalaureate education is compared.

3.1. Results of the Analysis of References to the Concept of Water in the Secondary and Baccalaureate Education Curriculum (SO1 and SO2)

To achieve specific objectives SO1 and SO2, Table 1 shows the total number of references to the concept of water, the frequency (n) and the percentage (%) over the number of references found in the curriculum of compulsory secondary education and baccalaureate, distinguishing by the established categories.

Table 1. Frequency (n) and percentage (%) of references to water in the secondary education curriculum (Royal Decree 1105/2014) by category.

Regulation	Values	Water and Society	Technology	Sustainability and Responsibility	Water	Total
Royal Decree 1105/2014	Frequency (n)	23	8	19	29	79
	Percentage (%)	29.11	10.12	24.05	36.70	100

As shown in Table 1, there are 79 references to the concept of water in the compulsory secondary education and baccalaureate curriculum in Spain. The analysis by category determines that the concept is mainly worked on at a conceptual level, since category IV (Water) has an incidence of 36.70%, followed by category I (Water and Society) with 29.11%. The categories with a less presence in the curriculum are category II (Technology), with a presence of 10.12%, and category III (Sustainability and Responsibility), with 24.05%. These results indicate that the concept of water is not addressed to a great extent during the six academic years covered by the educational legislation [74]. Despite the direct impact of water on human wellbeing, in the educational stages of compulsory secondary education and baccalaureate, this concept is not emphasized. It is not included in the educational plan at these levels and above all in aspects related to sustainable development.

Below are the results concerning the Specific Objective 2 (SO2) raised in this research. A qualitative analysis was carried out to check in which subjects the concept of water is studied and in which curricular elements appears. Tables 2 and 3 show the references to the concept of water, the subjects in which it is taught (as established on the curriculum), the academic level and to which element of the curriculum it belongs. These curricular elements are regulated by the legislation studied and are Contents (CO), Evaluation Criteria (EC), Learning Standards (LS) and Introduction (I) of the subject in question.

Table 2. Number of occasions in which the concept of water appears and percentage in the different subjects in the study plan of CSE. Abbreviations: Contents (CO), Evaluation Criteria (EC), Learning Standards (LS) and Introduction (I).

Subject	Royal Decree 1105/2014					Total References	%
	Year	CO	EC	LS	I		
Biology and Geology	1st	5	6	7		18	41.86
	3rd	5	6	7		18	41.86
Sciences Applied to Pro. Activity	4th	1	2	1		4	9.30
Physics and Chemistry	4th			1		1	2.32
Technology	4th	1		1		2	4.65
Total CSE		12	14	17	0	43	100.00

Table 3. Number of occasions in which the concept of water appears and percentage in the different subjects in the baccalaureate curriculum. Abbreviations: Contents (C), Evaluation Criteria (EC), Learning Standards (LS) and Introduction (I).

Subject	Royal Decree 1105/2014					Total References	%
	Year	CO	EC	LS	I		
Applied Anatomy	1st			2		2	5.55
Biology and Geology	1st		1	1		2	5.55
	2nd	1	1	1		3	8.33
Graphic and Plastic Expression Techniques	2nd		1	1		2	5.55
Earth and Environmental Sciences	2nd		5	6	1	12	33.33
Chemistry	2nd	1		1		1	2.77
Geography	2nd	1				1	2.77
Geology	2nd	5	4	3		12	33.33
Total Baccalaureate		8	12	15	1	36	100.00

Table 2 shows the results obtained for the stage of compulsory secondary education (CSE). Data are specified in frequencies (n) and percentages (%) referring to the subjects and curricular elements that involve the concept of water.

Table 2 shows that, for the secondary education stage, the curriculum comprises 12 contents, 14 evaluation criteria and 17 water-related learning standards. They are divided into several subjects, such as Biology and Geology, Sciences Applied to Professional Activity, Physics and Chemistry and Technology. The first two subjects cover most of these curricular elements in equal parts. During the compulsory secondary stage, the concept of water is studied in 4 subjects. During the first three years of secondary education, Biology and Geology is a compulsory subject, which shows that the concept of water is worked on during this period. In addition, in this subject, 18 references to the concept were found in the 1st year of CSE and another 18 references in the 3rd year of CSE. The rest of the references to water in this educational stage are found in the 4th year of CSE. Likewise, to continue studying this concept in the 4th of CSE will depend on the subjects that the student chooses in his educational itinerary (Technology, Sciences Applied to Professional Activity or Physics and Chemistry) since in this year there is no core subject that works the concept of water. In summary, the data shown in Table 2 show that the 4th year of CSE is the level that offers the most optional subjects to improve the cognitive domain of the student in relation to the concept of water.

Table 3 shows the results obtained after the analysis of the references to the concept of water in baccalaureate. Data are specified in frequencies (n) and percentages (%) referring to the subjects and curricular elements that consider the concept of water.

As seen in Table 3, in the baccalaureate stage, water is considered in 8 contents, 12 evaluation criteria and 15 learning standards, and it appears once in the introductory section of the subject Earth and Environmental Sciences. This subject comprises most references to water in the secondary stage. It is followed by Geology, with 5 contents, 4 evaluation criteria and 3 learning standards out of the total number of references. During the two years of baccalaureate, the concept of water is not taught in any of the core subjects of the three itineraries offered. Therefore, students would only receive training related to this concept if the school offered the subjects shown in Table 3, and the student chose one of them. That said, the concept of water appears in two subjects in the 1st year of baccalaureate, in the subject of Applied Anatomy and in the subject of Biology and Geology, with a percentage of 5.55% in each case with respect to the total number of references in this stage. In the 2nd year of baccalaureate, this concept is more important, if the subjects that incorporate it are chosen by the student. The references found at this level account for almost 90% of the total number of references in the baccalaureate. The subjects that focus more on the concept of water in their educational plans are Earth and Environmental Sciences

with 33.33% of references and Geology with 33.33% of references. The rest of the subjects at this level, Graphic and Plastic Expression Techniques, Chemistry and Geography also include water as a concept of study but in a very small proportion (5.55%, 2.77% and 2.77%, respectively).

3.2. Analysis of the Concept of Water by Categories

A category analysis is shown in order to see how the concept of water is addressed from the perspective of Education for Sustainable Development. Table 4 shows the references in the different categories for compulsory secondary education and for the baccalaureate.

Table 4. Number of references in compulsory secondary education and in baccalaureate in the different categories of the study.

Stage	CAT I Water and Society (WS)	CAT II Technology (T)	CAT III Sustainability and Responsibility (SR)	CAT IV Water (W)
CSE	15	6	10	6
Baccalaureate	8	2	9	23
TOTAL	23	8	19	29

Category I, Water and Society (WS), includes those references in which water problems are linked to human activity. It includes references related to environmental or social problems that affect our society and those in which the importance of showing awareness and ethics regarding these problems is highlighted. As can be seen in Table 4, there are 23 references in this category. A total of 8 belong to baccalaureate and deal with issues related to water pollution, such as the effects of surface and groundwater contamination, the salinization of aquifers or the origin of the main water pollutants. Likewise, references are also included that seek to make students aware of the importance of water for human well-being. Some examples of category I statements included in the baccalaureate stage are "*To value groundwater as a resource and the human influence on its exploitation*", "*Potential environmental water problems: aquifer salinization, subsidence and pollution*" or "*Knows and describes the origin and effects of surface and groundwater pollution*". The 15 statements included in the compulsory secondary stage (CSE) in the WS category also deal mainly with aspects related to water pollution, although in this case most references focus on the importance of water for human survival. Some literal statements are "*Recognizes the anomalous properties of water by relating them to the consequences they have for the preservation of life on Earth*", "*To value the importance of groundwater, to justify its dynamics and its relationship with surface water*" or "*To describe the properties of water and its importance for the existence of life*". Category II, Technology (T) includes references that emphasize technology as a means of improving water-related problems and facilitating access to water. Table 4 also shows 8 references in this category. Six of the eight statements appear in secondary education and refer to the detection of water pollutants, water treatment or symbols related to water supply facilities. Some examples of statements are "*Explains drinking water supply, dam design and siphon applications using the fundamental principle of hydrostatics*" or "*To specify the pollutants in the water and to provide information on the treatment of the water*". In the baccalaureate we only find two references to the concept of water in the Technology category. These are "*To know the systems of potabilization and purification of the wastewater*" and "*Diagram of the phases of potabilization and purification of water in a WWTP*", which are part of the Earth and Environmental Sciences area of the 2nd year of baccalaureate.

Regarding Category III, Sustainability and Responsibility (SR), it should be noted that statements were considered that allude to issues of sustainability and efficiency in the proper management of water and those related to the responsibility for the proper use of water. In the secondary stage there are 10 references included in this category (as shown in Table 4), and they are dealt with only in the subject of Biology and Geology in the 1st year of CSE (5 references) and in the 3rd year of CSE (5 references). These references mention topics such as the importance of preserving water, carrying out sustainable management of it and avoiding its overexploitation. Some examples are "*To justify*

and argue the importance of preserving and not polluting fresh and saltwater" and *"Values the importance of groundwater and the risks of its overexploitation"*. In baccalaureate there are 9 statements to water within the SR category distributed among 3 subjects, Earth and Environmental Sciences, Applied Anatomy and Geology. Here, the importance of correctly using water is once again stressed, but references are also included related to the main water quality indicators or the sustainable exploitation of groundwater. Some examples of statements are *"Proposes individual, state and intergovernmental attitudes and actions to minimize the environmental impacts of water pollution"* and *"To know the possible environmental effects of inadequate water management"*.

Category IV, Water (W) includes those statements that require students to learn about water conceptually. As shown in Table 4, there are 29 statements in this category. Only 6 belong to CSE, in Biology and Geology of the 1st and 3rd year. Some literal examples of statements are *"Describes the water cycle, relating it to changes in its state of aggregation"*, *"Groundwater, its circulation and exploitation. Geological action of the sea"* or *"Analyzes the erosion, transport and sedimentation activity produced by surface waters and recognizes some of its effects on the terrain"*. In baccalaureate, the 23 conceptual references on water are distributed in six subjects, and depending on the subject, the theoretical content varies. Most of them are dealt with in the 2nd year of the baccalaureate. Some examples are *"Describes the absorption of water and mineral salts"* in Biology and Geology from the 1st year of baccalaureate; *"Groundwater"* in Geography of the 2nd year of baccalaureate; *"The circulation of water through geological materials"* in Geology of the 2nd year of baccalaureate; *"Ionic balance of water"* in Chemistry of the 2nd year of baccalaureate; *"Describes the process of water eutrophication, assessing its consequences"* in Earth and Environmental Sciences of the 2nd year of baccalaureate or *"To choose and apply correctly the materials and instruments characteristic of the pictorial techniques in the production of personal works with water, solid, oily and mixed techniques"* in Graphic and Plastic Expression Techniques of the 2nd year of baccalaureate.

3.3. Qualitative Analysis of the Cognitive Demand for the Concept of Water in Educational Legislation (SO3)

This section shows the results obtained to achieve specific objective 3 (SO3) aimed at analyzing the cognitive demand required by the curriculum regarding the concept of water.

To assess this variable, Bloom's taxonomy was taken as a reference. The author divided how people learn into three domains (cognitive, affective and psychomotor), being the cognitive domain the one dealt with in the present study. Bloom's taxonomy divides this cognitive domain into several levels depending on the cognitive demand placed on the subject. These levels are, from lowest to highest cognitive demand, knowledge, comprehension, application, analysis, synthesis and evaluation. This study classifies the references found according to the cognitive demand required of the student, distinguishing by educational stage, compulsory secondary education and non-compulsory (baccalaureate). Table 5 shows the percentage and frequency of references on water linked to the different levels of cognitive demand required of the students.

Table 5. Frequency (n) and percentage (%) of cognitive demand levels according to Bloom's taxonomy for the concept of water (CSE).

Level	Frequency (n)	Percentage (%)
Evaluation	8	18.60
Synthesis	1	2.32
Analysis	5	11.62
Application	4	9.30
Comprehension	8	18.60
Knowledge	17	39.53
Total	43	100

As shown in Table 5, during the secondary stage, students are expected to acquire fundamentally conceptual learning in relation to water. The total percentage of knowledge (39.53%) and comprehension (18.60%) represents almost 60% of the cognitive demand required in this stage. It is worth noting the

18.60% obtained in the evaluation level. This is the most difficult cognitive level established in Bloom's taxonomy, although this figure is far from being very favorable. This level is followed in percentage by the cognitive level of analysis with 11.62% in the secondary education curriculum and the cognitive level of application with 9.30%. The least demanded cognitive level at this educational stage is the level of synthesis with 2.32% of incidence in the analyzed regulation.

Table 6 shows the percentage and frequency of references to water linked to the different levels of cognitive demand required of students in baccalaureate.

Table 6. Frequency (n) and percentage (%) of cognitive demand levels according to Bloom's taxonomy for the concept of water (Baccalaureate).

Level	Frequency (n)	Percentage (%)
Evaluation	5	13.88
Synthesis	2	5.55
Analysis	3	8.33
Application	2	5.55
Comprehension	7	19.44
Knowledge	17	47.22
Total	36	100

Once again, the levels of knowledge (47.22% of incidence) and comprehension (19.44% of incidence) are the most demanded. The evaluation level follows with 13.88% of the cases in baccalaureate, although, as in secondary education, the level of evaluation required of baccalaureate students is far from adequate. The two cognitive levels least in demand from baccalaureate students are the level of application and the level of synthesis, with a 5.55% incidence in both cases.

Figure 1 shows compares levels of cognitive demand for compulsory secondary education versus the baccalaureate. The level of knowledge is the same at both stages, although there are minor differences in the other levels of cognitive demand depending on the academic level.

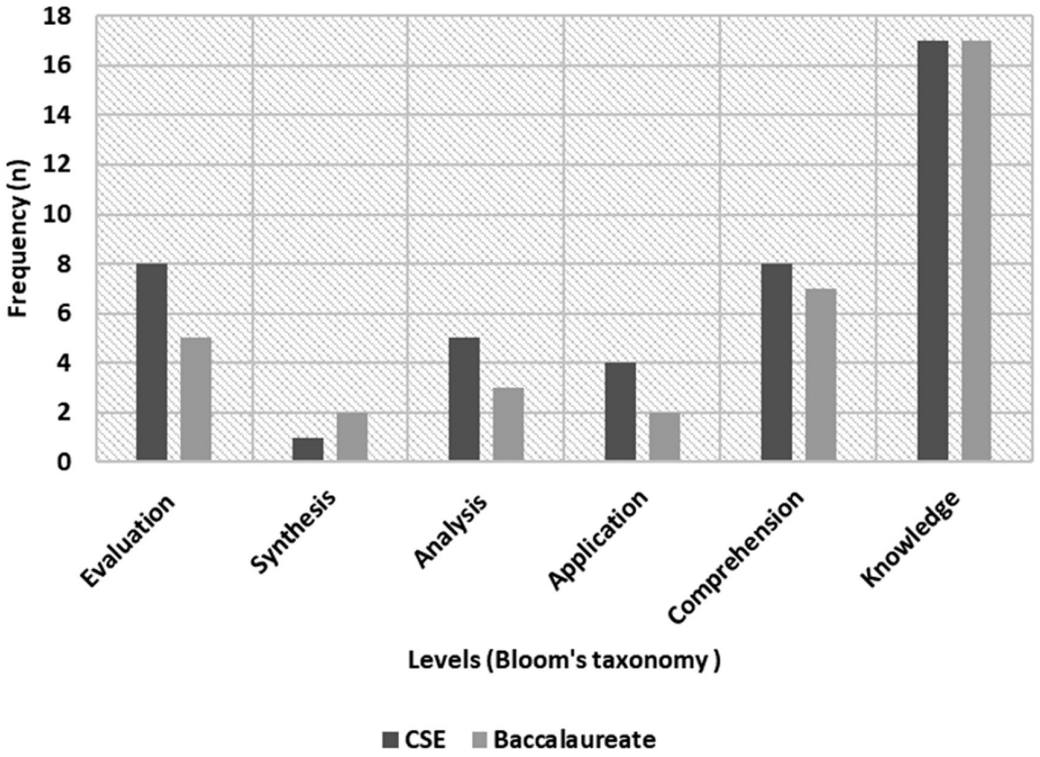

Figure 1. Cognitive demand for compulsory secondary education and baccalaureate.

3.4. Comparison Between the Secondary Education and Baccalaureate Curriculum and the Primary Education Curriculum in Relation to the Concept of Water (SO4)

This section shows the results referring to specific objective 4 (SO4). We aim to analyze the relative presence of references to water in Royal Decree 1105/2014 (the regulations governing secondary education and the baccalaureate), compared to the total references to this concept in Royal Decree 126/2014 (the regulations governing primary education). Table 7 shows the total references to the concept of water in each educational curriculum, distinguishing by category established in each case.

Table 7. Number of times (n) and percentage (%) that primary and secondary and baccalaureate educational regulation mention water in each category established.

Legislation	Values	Water and Society	Technology	Sustainability and Responsibility	Water	Total
Primary Education (Royal Decree 126/2014)	Frequency (n)		2	1	21	24
	Percentage (%)		8.33	4.16	87.5	100
Secondary Education (Royal Decree 1105/2014)	Frequency (n)	23	8	19	29	79
	Percentage (%)	29.11	10.12	24.05	36.70	100

As shown in Table 7, the concept of water is considered 79 times in the secondary and baccalaureate curriculum and 24 times in the primary curriculum. The comparison by categories determines that said content, both in primary and secondary education, acquires a more conceptual character. That is because most of the references found are included in the Water category in both cases. It should be noted that in primary school, the content would hardly be linked to actions or attitudes based on sustainable development. There is only one reference in the Sustainability category at that educational stage. However, the data show that in the secondary and baccalaureate stages, water is related to aspects related to sustainability to a greater extent. There are 19 references in the Sustainability category. The references on water improvement technologies are addressed very little during the training of students, regardless of the educational stage. Only two references related to this category were found in primary education and 8 in secondary education and baccalaureate (the Waste and Society category was not considered in primary school because no references were found that could be included in this category). With secondary school and baccalaureate, the established regulations consider water 23 times in this category, as stated in previous sections.

4. Discussion and Conclusions

The analyses conducted allow us to describe the current situation regarding the introduction of water sustainability in the Spanish secondary and baccalaureate education curriculum. Study results show that it is necessary to place greater emphasis on water content focused on education for sustainability from the earliest ages. According to studies [83], it is not until the higher levels of this stage that water is recognized as an essential day-to-day tool. The present study shows that the educational regulations of secondary education and baccalaureate treat the concept of water with some depth. However, most of the subjects that include it are optional, and therefore, it cannot be assumed that students will receive training in relation to this concept during these years. There are 10 subjects in the plan in which this concept is worked on. This it is done mostly in a theoretical and conceptual way rather than in a procedural way and related to a sustainable perspective. We consider that it would be interesting to add more content on water from a sustainable perspective in the school framework. Thus, it will complete quality training on awareness and sustainable management of water. We cannot forget that among the Objectives of Sustainable Development [12] is the development of knowledge, attitudes and skills regarding this resource and to help people and social groups develop their sense of responsibility. Moreover, it fosters individual and collective work to prevent and solve environmental problems [84]. We suggest that more disciplinary approaches to the treatment of water be included in the primary school curriculum. The ultimate aim is to instill in the youngest children the measures for the correct use and conservation of water [85,86].

4.1. Curricular Shortcomings and Lack of Institutional Policies

Considering the contents included in the curriculum about water, it is likely that textbooks will highlight points of view with political, geostrategic and economic interests in the subject [87]. These notions, if presented out of context, transmit an erroneous idea of the problem [88]. We agree with [70] that the contents of the educational system to change attitudes and habits in relation to water are aimed at the field of reducing personal and domestic consumption and the use of domestic and efficient technology. There is a lack of other approaches that show a critical point of view on the large consumers and water wasters, the economic interests of the construction companies of large dams and hydroelectric plants and the desires of urban development. In this sense, the teaching and learning of water must address a framework that seeks to develop competencies for action [70]. For example, in addition to dealing with aspects related to the water quality, it must consider its flow, the virginity of the banks and riverbeds and the presence of species that indicate quality. In relation to the state of the waters, it should address issues that include what type of river and under what conditions social participation is decided or encourage attitudes of enjoyment of the beauty of natural systems over purely economic interests.

The results found in this work are consistent with the contributions of previous studies that analyze the concept of water in the educational curriculum. We agree with [89] that there is no clear policy by the institutions to implement issues related to sustainability in teaching, so an institutional reorganization is required in this sense. We also agree with [90] and [91] that education for sustainable development in higher education has made little progress and that changing the curriculum remains a major challenge. Likewise, our results are also in line with those stated by [92], authors who consider the need to include economic, social and natural content in the curricula of the different courses to train professionals capable of acting critically in favor of sustainability. It is also worth mentioning the contributions of [66] that show that Iceland's curricula for early childhood, compulsory education and upper secondary education contain very few direct references to sustainability and education for sustainable development.

Likewise, the results obtained in the analysis of the Spanish curriculum in terms of sustainability coincide with the analysis of the secondary education curriculum of English schools carried out by [93], which states that education policy makers do not pay enough attention to education for sustainable development in secondary education curricula. Our findings do not coincide with those found by [94], who states that India is perhaps the only country where education policies have advocated the immediate incorporation of education for sustainable development at all levels of formal education. However, this study [94] also shows that the effective implementation of ESD is hampered by the lack of interdisciplinary competence of teachers and traditional assessment methods in higher education.

4.2. Need to Improve the Curriculum and of New Approaches

Sustainability is a shared responsibility and therefore we agree with previous studies [89] that its integration in the curricula needs to be improved. In this way, classroom actions for the development of specific competencies in sustainability begin to be planned from the earliest educational ages. However, to achieve a change in this sense, it will be necessary to integrate the concepts of sustainability in the curriculum but also to innovate in the classroom proposals [95]. There is a need to develop more flexible teaching models that cover the entire curriculum to encourage a holistic perspective on the environment [90].

The challenges of sustainability require innovative educational approaches and solution-oriented projects to transform society. We agree with [96] on the need to develop curricula that more explicitly address the interconnectedness of different aspects of sustainable development and that use pedagogies that help students act on these challenges. Teaching and learning processes should make students aware of water issues in all their dimensions [97], as students strongly associate sustainability with environmental aspects and neglect the economic, social and cultural dimensions [96]. In this sense,

the curricular elements of the areas intended for water education should also be oriented towards other issues.

For example, in Category IV (Water), we should not only focus on groundwater, its circulation or the geological action of the sea. It is also necessary to understand the spatial and temporal dynamics of water [98]. In Category II (Technology), we should also look beyond understanding the technical scope of drinking water and wastewater treatment systems. Thus, another key topic should be raising awareness of the importance of storing and conserving natural water resources [99]. In Category I (Water and Society) we cannot focus solely on aquifers or groundwater, as attention should also be paid to identifying water uses and conservation [100]. References found in all categories focus at the local level but promoting actions to understand the unequal availability of water at the global level should not be forgotten [101]. All these approaches help to generate a better understanding of water management among students [37].

In addition, meaningful learning is essential to fostering environmental awareness among students. Using active methodologies that allow for greater understanding in the teaching of key aspects of sustainability, such as water [12], is fundamental [37]. In this line, practical activities are very important. They can enable students to analyze issues related to access to water and explore a responsible use. The students will also be able to understand why water scarcity is a public concern and why access to fresh water is a basic human right [102].

4.3. Limitations of the Study and Future Research

Regarding the limitations of this study, there are some derived from the design of the categories themselves. Although the categories have proved to be very informative and have fulfilled their role, they have also proved to be insufficient for analyzing some issues of the study in more depth. There is a need for more comprehensive research on sustainability in the curriculum [103–105] and, above all, on specific topics of sustainability. We believe that it is necessary to introduce a new approach to water in educational plans. The objectives, the contents, the evaluation criteria and all those formal aspects of the curriculum should fit perfectly into the didactic units in which the activities about water are framed. This should be done in all the necessary subjects and throughout the whole educational period, giving the concept of water the importance, it deserves. It would also encourage awareness and a change in attitude that would lead to a more respectful and sustainable use and management of this valuable and indispensable resource [106]. Another limitation of this analysis is that it is limited to curricula. If activities and contents of various textbooks of the subjects that include water as a concept had also been analyzed, maybe the results would be more informative. The perspective of teachers and students could also be included with questionnaires or in-depth interviews to complete the descriptive study. Those are, therefore, potential lines of future research.

This work could be a starting point for the administration to redesign the curricula. The transition to sustainability education in the classroom must be achieved through practices directly linked to key issues. Examples of such issues include conserving natural resources, protecting local biodiversity, mitigating climate change, generating social welfare or saving money. In this sense, our recommendations are aimed at strengthening the continuous training of both training and in-service teachers. That is why a line of future research could be focused on planning a professional development program for teachers that recognizes the importance of this field and its particularities. However, it would also be interesting to analyze students' perceptions of integrating environmental and sustainable development education in secondary schools. As a result of their judgements, teachers could help to ensure that their behavior is appropriate and consistent with the particularities of the environment.

These programs are necessary because they provide an opportunity to develop the key characteristics of education for sustainability [107]. Another line of research could be related to analyzing teachers' perceptions regarding the integration of environmental and sustainable development education in secondary schools, thus complementing recent studies on this topic [108].

4.4. Conclusions

Today's students will eventually decide on the future use of water resources, so education is the most efficient way to equip the next generation with knowledge and attitudes that promote the wise use of water and appropriate behavior [102]. It will be essential that during the early years of education, young people gain lifelong learning and awareness to make value judgements about water based on valid and meaningful knowledge [109]. Therefore, we emphasize the need for the basic regulations governing the curriculum in compulsory education to address sustainability, a crucial element in the formation of citizenship based on an initial reference scheme that integrates the various social, environmental and economic dimensions involved and ensures their presence, in a balanced way, in the various subjects and through a progressive and interdisciplinary treatment throughout this educational stage [76]. In this way, it would be possible for citizens to have their own unbiased opinion and generate correct attitudes towards the care of the environment [36].

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