Article

Sustainable Development Goals and Climate Change in Spanish Technology Disciplines’ Curricula: From LOMCE to LOMLOE

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Abstract: Understanding the prevalence of climate change and sustainable development in the new curriculum of compulsory secondary education (ESO) and the baccalaureate is crucial for educational communities in Spain. However, there was a lack of studies that examined the integration of climate change and Sustainable Development Goals (SDGs) as cross-cutting themes in the new education framework, particularly in the technology disciplines. This study aimed to address this gap by conducting a comparative analysis of the new legislative content (LOMLOE) and the previous legislation (LOMCE). The analysis quantified the presence of keywords related to climate change and sustainable development in both legal texts, focusing on the definition of objectives, level skills, evaluation criteria, and blocks of knowledge. Additionally, the study assessed the inclusion of SDGs and the ethical implications associated with the use and production of technologies at both education levels. The analysis of the curriculum content revealed a significant presence of references to climate change, sustainable development, and SDGs throughout the LOMLOE curriculum, particularly in the baccalaureate. Notably, education’s role in addressing climate change and promoting sustainable development was explicitly recognized as an objective at this level. Regarding technology disciplines, LOMLOE placed considerable emphasis on fostering awareness of the environmental impact of technological development by introducing a new cross-level knowledge block named “Sustainable Technology”, spanning from ESO to the final courses of baccalaureate. This integration was further reinforced by evaluation criteria and specific skills that strongly aligned with sustainability principles, encouraging assessments centred around environmental awareness, ethical responsibilities, and sustainable entrepreneurship. Further studies are required to evaluate the effectiveness of incorporating SDGs and climate change into technology disciplines following the implementation of LOMLOE, with the aim of identifying best practices for effectively combatting climate change and promoting sustainability in technology education.

Keywords: education on sustainability; Sustainable Development Goals (SDGs); climate change; European education; 2030 Agenda; technology education

1. Introduction

Addressing the climate crisis requires a collaborative effort involving citizens in decision-making and as agents of social and economic change. It is imperative to educate people about climate change, not just through environmental campaigns and informal education, but also through formal education [1,2]. However, the transition to a sustainable society can be hindered by people’s reluctance to change their consumption habits. For example, while most people in Spain acknowledge that climate change is a major issue that
needs to be urgently addressed, they are often resistant to implementing measures that would change their consumption patterns [3]. Introducing sustainable development and climate change into the curriculum will help teachers to reduce many of the misconceptions related to sustainability, and also to shape the sustainable behaviours of future generations [4–6]. In this context, integrating sustainable development into technology education in secondary and higher education could be crucial in empowering future innovators to create green technologies, with minimal impact on the environment while the way that people consume technology is transformed [7].

In 2015, the United Nations (UN) established the 2030 Agenda for Sustainable Development [8]. It establishes an action plan in favour of the planet, people, and prosperity through the definition of seventeen goals for sustainable development (SDG) and one hundred and sixty-nine goals to be achieved by the year 2030. Among the seventeen objectives, there are five (SDG-13 dedicated to climate action, SDG-7 related to affordable and clean energy, SDG-11 related to the sustainability of cities and communities, SDG-12 focused on obtaining responsible production and consumption, and SDG-15 focused on maintenance of terrestrial ecosystems) that are closely related to climate change and technology development. Following the same guidelines in December 2019, the European Commission published the “Green Deal” [9], with the commitment of all member countries of the European Union (EU) to the search for a new economic growth strategy towards a sustainable future that responds to the challenges of climate change. This pact was ratified in June 2021, where Regulation (EU) 2021/1119 of the European Parliament and of the Council established the framework for achieving climate neutrality known as the “European Climate Law” [10]. To achieve the goals of a sustainable economy and society, with zero emissions and no pollution by 2050, the direct involvement of all citizens is required. Specifically, in Section 2.2.4 of European Green Deal emphasizes the need to activate the teaching and training of students regarding the economic and social transition. In both regulations, the 2030 Agenda and European Climate Legislation, education is the backbone, not only to transform our consumption habits but also in the training of personnel with the appropriate skills to carry out the necessary economic, social, and industrial change.

Since 1987, when the Brundtland Report for the UN was published, technological development has been confronted with environmental sustainability. The Brundtland Report defined for the first time the keywords “sustainable development” as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs” [11]. This vision brings together economic and social dimensions with the environmental dimension. Very few educational programs intentionally approached climate change from both social and science disciplines [6]. However, integrating the Sustainable Development Goals (SDGs) and climate change into the secondary school technology curriculum is crucial for the education of future innovators who will need to develop sustainable technologies that minimize their impact on the environment. This integration can help to foster a culture of innovation and entrepreneurship with a focus on sustainability, while also raising awareness of the importance of responsible consumption and production practices. By equipping students with the skills and knowledge necessary to develop sustainable technologies, they will be better prepared to face the challenges of the 21st century, including the impacts of climate change. Additionally, this integration will help to bridge the gap between technology education and environmental education, providing a more holistic approach to sustainable development. Overall, the integration of the SDGs and climate change into the technology curriculum of secondary schools can help to develop a more environmentally conscious and responsible citizenry.

In this work, we analysed how climate change and Sustainable Development Goals are included in the recently approved curriculum for the technology disciplines of the new secondary education and baccalaureate under the Spanish Education Law. The introduction of climate change and Sustainable Development Goals will support the transformation of technological and economic development, which will be led by the new Spanish gen-
erations fuelling the social and economic transition to adapt, mitigate, and be resilient to climate change.

Therefore, we analyse how the approval of the 2030 Agenda influenced the new educational legal framework approved in 2022 in Spain regarding climate change and sustainable development [12–14]. More specifically, we focus on the technology disciplines of the compulsory secondary education (ESO) [12] and baccalaureate [13] curriculum, since they establish the training skills for future engineers and developers who will lead the transformation of Spanish industry towards the production and consumption of clean, sustainable technologies.

Specific objectives are:

1. To study the prevalence of climate change and sustainable development in the curriculum of the ESO and baccalaureate of the new Organic Law 3/2020 of December 29 for the Modification of the Education Law (LOMLOE) [14];
2. To compare the application of climate change and sustainable development between the legislative content of the education framework approved in the Organic Law of Education 8/2013 of December 9 (LOMCE) [15] and the new one approved in 2022 (LOMLOE) [12–14];
3. To study the distribution within technology disciplines of the inclusion of climate change, sustainable development, and the Sustainable Development Goals (SDG) of the Agenda 2030.

We focused on the comparison between the LOMLOE (2021) and the LOMCE (2013) since they are two legal texts that temporarily frame the approval of the 2015 Sustainable Development Goals. LOMLOE is a modification of the LOE. However, we chose not to include the oldest legal text, since the year 2015 with SGD was considered as the central point of analysis.

2. Literature Review

There is a global consensus that education curricula are not meeting the needs of modern society in the technological era. For example, in the curriculum of the previous Spanish Education Law (LOMCE) [15] there was a limited presence of sustainability in the curriculum with deficiencies in the inclusion of social and economic dimensions and, with a questionable optimism, it saw technology as the solution to sustainability problems. If we compare this with the Portuguese curriculum, both cases show similar deficiencies, with the main education in sustainability focused on geography education with no significative relevance in technology disciplines [16]. Recent studies revealed that the curriculum in Irish schools shows an absence of a coherent policy across all technology disciplines concerning its social and economic impact. However, training new generations in technology is required to promote their critical thinking about technological development towards sustainability, and challenge both teachers and students to raise awareness of environmental issues [17]. In Croatia, pupils view technology as important for life and progress but do not understand how it relates to sustainable development and environmental issues [18]. However, for Eigido Galvez, the effort that many countries are making to develop a school curriculum consistent with the educational demands of the 21st century is evident [19]. For example, European countries such as the Netherlands are currently working to develop a quality curriculum in the technological era, starting from the initial stages and giving a similar relevance to digital literacy and languages of maths [20]. In this study we aim to analyse how sustainable development and climate change are introduced in the curriculum of the LOMLOE focused on the technology disciplines, giving emphasis to how, in this technological era, education in sustainability can play a crucial role in the formation of the next generation of technology entrepreneurs in Spain.

The new educational law, LOMLOE, triggered a wide debate in Spanish society and aroused the interest of the scientific community. Researchers from different areas of knowledge analysed data and presented results, highlighting strengths and potentialities as well as weaknesses and threats associated with the new legal text. There are numerous
relevant issues evident in multiple social and political contexts [21]. From Arts to Law, passing through Philosophy, History [22], or Languages [23], multiple educational areas consider it pertinent to investigate LOMLOE and its implications. For example, Huerta and Dominguez call attention to the reduction of time dedicated to the visual arts in the new curriculum law [24]. Some studies address issues that have generated controversy in society, such as the promotion of co-education as an opposition to differentiated education (separation of male and female students) [25,26]. Other studies address issues related to educational and religious rights and the freedoms of parents, teachers, and students as constitutional rights [27]. Related to science, García-Carmona identifies several weaknesses, finding that “The results show that Spain’s science curriculum for compulsory secondary education is not consistent in either quantity or depth with the PISA framework concerning the understanding of the epistemic aspects of NOS (nature of science)” [28]. However, there are also works published on LOMLOE that recognize and underline its strengths and/or associated good practices, often aligned with international educational trends, to which the Spanish state is added. For example, Montero Caro [21] values the new LOMLOE law as a Spanish legislative instrument because it presents changes and concrete measures to achieve the Sustainable Development Goals defined for the millennium. She remarks on the relevance, especially in relation to quality education (SDG4), of ensuring equitable opportunities for all, mainly after COVID pandemic, which showed us that quality education is not inclusive for all [29]. Gavari-Starki [30] remarked that LOMLOE includes, for the first time, innovative approaches for education on sustainable development or Global Citizenship, including direct references to sustainability with SDGs being a vehicle to prepare the new generations for the critical consequences of climate change. This is especially relevant to the promotion of entrepreneurship education in technology disciplines as a motor for transforming our economy and creating the next generation of sustainable entrepreneurs, which will lead to more sustainable businesses in a more sustainable society [31,32].

Furthermore, we would like to remark that education on climate change was mainly relegated to environmental education campaigns and non-formal education [2]. Therefore, the students who accessed the information related to climate change mainly through biased digital media [33,34]. Specifically, in disciplines with the potential for promoting sustainable technological innovation, such as “Technology” or “Physics and Chemistry”, the LOMCE only presents isolated references to sustainability [16]. In this context, the new Organic Law—LOMLOE [14], which modifies the LOMCE [15], aims to incorporate the international recommendations and guidelines of the European educational system into national law. Recent studies have shown that LOMLOE as an Organic Law has incorporated sustainability as an axis of the Spanish education system [30]. In this work, we want to move further to study how the last approved curriculum in the royal decrees 217/2022 [12] and 243/2022 [13] has incorporated sustainable development and its relationship with climate change in the technology disciplines. We examine the challenges and opportunities for technology education and promoting sustainability.

3. Materials and Methods

The methodology used in this research has a qualitative aspect, concentrating on documentary and content analysis supported by a methodological procedure for the collection and analysis of relevant information. The content analysis was approached via systematic procedures that allow observation of the content without interpretations of latent meanings. Therefore, we use standardized and quantitative measures to compare legislative texts.

The sources of information that were selected based on current and national relevance criteria are presented below, from which the data were extracted to obtain the pertinent results according to the objectives defined for the study:

- Organic Law 8/2013, of December 9, for the improvement of educational quality—LOMCE [15];
Royal Decree 1105/2014, of December 26, establishing the basic curriculum for compulsory secondary education and baccalaureate—LOMCE [35];


Royal Decree 217/2022, of March 29, which establishes the organization and minimum teaching of compulsory secondary education—LOMLOE [12];

Royal Decree 243/2022, of April 5, which establishes the ordination and the minimum teachings of the baccalaureate—LOMLOE [13].

The study starts with a descriptive–comparative analysis of the presence of references to keywords associated with climate change and sustainable development within the legal texts indicated previously as sources of information. To carry out a quantifiable study of the presence of climate change in the ESO and baccalaureate curricula, we have created a table of keywords that refer directly or indirectly to climate change and sustainable development (Table 1). Following the model developed by Navarro-Díaz for the analysis of climate change in textbooks, we have considered the use of keywords such as “climate change” or “global warming” as a direct way of referring to climate change, while keywords such as “sustainable development” or “environment” do so indirectly [2]. The list of considered references and their classification can be seen in Table 1.

Table 1. Keywords used to identify the references to climate change and sustainable development in the curriculum of compulsory secondary education and baccalaureate in Spain.

<table>
<thead>
<tr>
<th>Keyword (Spanish)</th>
<th>Keyword (English)</th>
<th>Subcategory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambio Climático</td>
<td>Climate Change</td>
<td>Definition</td>
</tr>
<tr>
<td>Globalización</td>
<td>Globalization</td>
<td>Cause</td>
</tr>
<tr>
<td>Efecto Invernadero</td>
<td>Greenhouse Effect</td>
<td>Cause</td>
</tr>
<tr>
<td>Emergencia Climática</td>
<td>Climate Emergency</td>
<td>Consequence</td>
</tr>
<tr>
<td>Crisis Climática</td>
<td>Climate Crisis</td>
<td>Consequence</td>
</tr>
<tr>
<td>Calentamiento Global</td>
<td>Global Warming</td>
<td>Consequence</td>
</tr>
<tr>
<td>Medioambiente</td>
<td>Environment</td>
<td>Protection of Natural Spaces</td>
</tr>
<tr>
<td>Problemas Medioambientales</td>
<td>Environmental Problems</td>
<td>Protection of Natural Spaces</td>
</tr>
<tr>
<td>Mitigación y Adaptación</td>
<td>Mitigation and Adaptation</td>
<td>Socioeconomic</td>
</tr>
<tr>
<td>Sostenibilidad</td>
<td>Sustainability</td>
<td>Socioeconomic</td>
</tr>
<tr>
<td>Desarrollo Sostenible</td>
<td>Sustainable Development</td>
<td>Socioeconomic</td>
</tr>
<tr>
<td>Consumo Responsable</td>
<td>Responsible Consumption</td>
<td>Socioeconomic</td>
</tr>
<tr>
<td>Economía Circular</td>
<td>Circular Economy</td>
<td>Socioeconomic</td>
</tr>
<tr>
<td>Objetivos de Desarrollo Sostenible (ODS)</td>
<td>Sustainable Development Goals (SDGs)</td>
<td>Socioeconomic</td>
</tr>
<tr>
<td>Retos Globales</td>
<td>Global Challenges</td>
<td>Socioeconomic</td>
</tr>
<tr>
<td>Retos del Siglo XXI</td>
<td>Challenges of the 21st Century</td>
<td>Policy</td>
</tr>
<tr>
<td>Agenda 2023</td>
<td>Agenda 2023</td>
<td>Policy</td>
</tr>
</tbody>
</table>

Source: own elaboration from the text of LOMLOE.

We conducted a data collection analysis to examine the frequency and percentage of keywords, as defined in Table 1, within the legal texts. The collected data were categorized into two sections. Firstly, we determined the frequency of keyword citations in the general definition of both organic laws, LOMCE and LOMLOE. This analysis allowed us to assess the prominence and explicit mention of the keywords within the overarching legal framework. Secondly, we analysed the frequency of keyword citations in the curriculum definition across all technology disciplines in ESO and baccalaureate in both laws. This examination provided insights into the integration and emphasis of the keywords across different areas at both educational levels. To provide a comprehensive understanding, it is noteworthy to mention that, in the case of the technology disciplines under LOMLOE, the frequency and percentage of keyword citations were analysed in three distinct sections: objectives ("objetivos"), general skills ("competencias clave"), and disciplines ("materias"). This study finished by focussing on the technology disciplines of LOMLOE and how climate change, sustainable development, and the SDG are included in the definition of
specific skills ("competencias específicas"), evaluation criteria ("criterios de evaluación"), and blocks of basic knowledge ("saberes básicos") by evaluating the correlation between the presence of different keywords along the temporal progression in the curriculum.

4. Results
4.1. Climate Change and Sustainable Development in Spanish Educational Regulations

The keywords “climate change” appear for the first time in an organic law on education after the approval of Organic Law 3/2020 of December 29, which modifies Organic Law 2/2006 of May 3 on education. It appears three times in total, in points as important as the baccalaureate objectives (Title I, Chapter IV, article 33, objective o “Fomentar una actitud responsable y comprometida en la lucha contra el CC y en la defensa del desarrollo sostenible”, in English “To promote a responsible and committed attitude in the fight against climate change and the defence of sustainable development”, page 34), the objectives of adult education (Title I, Chapter IX, article 66, objective i “Desarrollar actitudes y adquirir conocimientos vinculados al desarrollo sostenible y a los efectos del CC y las crisis ambientales, de salud o económicas y promover la salud y los hábitos saludables de alimentación, reduciendo el sedentarismo”, in English—“To Develop attitudes and acquire knowledge related to sustainable development and the effects of climate change and environmental crises, health or economic and promote health and healthy eating habits, reducing sedentary lifestyle”, page 49), and the modification of article 110 where the accessibility, sustainability, and relations with the environment of the regulations of educational centres are defined (Title IV, page 66).

If we analyse in detail the presence of the keyword in the ESO and baccalaureate curriculum, in the case of the LOMCE the keywords “climate change” are mentioned in five disciplines, three in the ESO curriculum ("Ciencias Aplicadas a la Actividad Profesional”, "Cultura Científica", “Valores Éticos”) and two in the baccalaureate ("Geografía", “Geología”). In the case of LOMLOE, the keywords “climate change” appear in the descriptors of seven disciplines, three from ESO ("Biología y Geología", “Educación en Valores Cívicos y Éticos”, “Geografía e Historia”), two from the baccalaureate ("Biología", “Geología”, “Ciencias Ambientales” in the Science and Technology Modality) and two in the definition of specific modules of Basic Vocational Training ("Ciencias Aplicadas", “Comunicación y Ciencias Sociales"). There are no major differences in the frequency of appearance of the keywords. However, it should be noted that in the LOMLOE, climate change is specifically named in the objectives of the baccalaureate (objective o) and the operational descriptors of one of its skills, the CC4 citizen skill: CC4. It analyses the relationships of interdependence and ecodependence between our ways of life and the environment, carrying out a critical analysis of the ecological footprint of human actions, and demonstrating an ethical and ecologically responsible commitment to activities and habits that lead to the achievement of the SDGs in relation to sustainability and the fight against climate change.

Figure 1 shows the frequency of citation of direct references to climate change in the LOMCE and LOMLOE curricula. In the case of the LOMCE, reference is made to climate change directly a total of twenty times, while in the LOMLOE reference is made 10% more. The differences in the use of keywords between both curricula should be highlighted. While the LOMCE uses keywords that refer to the definition and phenomenology of climate change, the LOMLOE uses keywords that refer to action strategies highlighting the urgent need for change (for example, “climate crisis” or “climate emergency”). It should be added that the keyword “greenhouse effect” that appears in the LOMCE has completely disappeared in the text of the LOMLOE, noting that it is currently considered that the greenhouse effect is not the only consequence of climate change.
be added that the keyword “greenhouse effect” that appears in the LOMCE has completely disappeared in the text of the LOMLOE, noting that it is currently considered that the greenhouse effect is not the only consequence of climate change.

Figure 2 shows the frequency of the appearance of indirect references to climate change, including those associated with sustainable development in the LOMCE and LOMLOE curricula. While, in the LOMCE, the indirect reference with the greatest presence was globalization, in the LOMLOE it is drastically displaced by sustainability and sustainable development. Thus, in the LOMLOE the presence of references to “sustainability” and “sustainable development” has increased from five to 118 and from 10 to 115, respectively (Figure 2). It is worth noting the use of the keyword “responsible consumption”, as an act of a personal and ethical nature in the face of climate change did not appear in the LOMLOE curricula. While, in the LOMCE, the indirect reference with the greatest presence was globalization, in the LOMLOE it is drastically displaced by sustainability and sustainable development. This has a wide presence in the LOMLOE curriculum, appearing more than forty times in the text. Thus, if the texts of the LOMCE and LOMLOE curricula are compared, climate change and sustainable development appear directly or indirectly 600% more in the LOMLOE than in LOMCE.

**Figure 1.** Frequency of keywords related to the definition, causes, and consequences of climate change in the curriculum of ESO and baccalaureate of LOMCE and LOMLOE.

**Figure 2.** Frequency of keywords related to socioeconomics and policies on climate change and sustainable development in the curriculum of ESO and baccalaureate of LOMCE and LOMLOE.
Regarding the 2030 Agenda, we must highlight the appearance for the first time of the references “Sustainable Development Goals—SDGs”, “2030 Agenda”, or “Challenges of the 12th century” in a Spanish educational law after the approval of the LOMLOE. However, it must be considered that their presence cannot be analysed concerning the LOMCE, since they are correlated with political strategies that were approved after the approval of the royal decree. Nonetheless, the appearance of these keywords clearly reveals the influence of the approval of the 2030 Agenda in the recently approved Spanish education law.

Not only is it important how often climate change and sustainable development are referred to in the educational curriculum, but it is also important to note in which specific parts of the text reference are made. To do this, in Figure 3 we show the presence of the two direct references to climate change (Climate Change, Climate Emergency) and the four most frequent references to sustainable development (Sustainability, Sustainable Development, SDGs, Responsible Consumption) depending on the section of the curriculum of the LOMLOE of ESO and of the baccalaureate in which they appear. If we compare the results obtained in the definition of skills, we can see that references to climate change and sustainable development appear a total of ten times, both in the definition of key skills in the ESO curriculum and the baccalaureate curriculum. However, in the case of the definition of the disciplines of both stages, the references to climate change and sustainable development are much more present than in the skills, appearing up to two hundred times in the case of the definition of the disciplines of the baccalaureate. It should be noted that references to climate change and sustainable development are, in particular, more relevant in the case of baccalaureate disciplines than in ESO disciplines, where they are cited twice as often.

Figure 3. The number of citations of the most frequently cited keywords associated with sustainability in the general skills and description of disciplines of the curriculum of LOMLOE.
4.2. Climate Change and Sustainable Development in Curricular Skills

If we analyse the skills of LOMCE and LOMLOE, we can see that there is a clear difference in the definition of skills between both curricula. The LOMCE curriculum defines seven skills to which reference is made in the description of the disciplines. However, in the LOMLOE-approved curriculum, two types of skills are defined: key skills and specific skills. In the case of specific skills, these are linked to specific disciplines and the basic knowledge that students will learn in each of them. In the case of the key skills, each one is defined in a series of operational descriptors where the output profile to be achieved by the students in each of the stages is specified in detail, from primary to high school. As shown in Figure 3, many of the skills refer to climate change and sustainable development. However, what is most remarkable is that it is done very clearly in the key skills correlated with technological development, such as “Mathematical skill and skill in science, technology and engineering (STEM)”, “Digital skill (CD)”, and the “Entrepreneurial skill (EC)”. Thus, in the case of the STEM3 and STEM5 descriptors of both stages, the development of projects is linked to taking into account the importance of sustainability or the preservation of the environment and the global impact by promoting responsible consumption. In the case of the CD4 and CD5 descriptors of both stages, direct reference is made to sustainable development, the environment, and the critical and ethical use of technologies. Finally, in descriptor CE1 of both stages, reference is made to sustainability and the importance of evaluating the impact that the implementation of innovative technological solutions may have on the environment. This indicates that it is expected that in technology disciplines there may be major changes in the implementation of the disciplines in order to achieve the exit profile of the students in each of the stages.

In addition to the key skills that can more directly affect technology disciplines, climate change and sustainable development also appear in global key skills, such as the Citizen Skill (CC) in CC2 and CC4 skills, where sustainable development alludes to ecodependence and a sustainable and ecosocially responsible lifestyle. In addition, in the baccalaureate curriculum, climate change is directly mentioned in CC4, promoting ethical commitment to the fight against climate change.

4.3. Climate Change and Sustainable Development in Technology Disciplines

Each discipline in the LOMLOE curriculum includes a description where the basic knowledge, the specific skills, and their relationship with the descriptors of the key skills are defined, the latter being the evaluation criteria for each of the corresponding knowledges. For this reason, in this part we conduct a quantitative analysis of the references present in Table 1 in the description of technological disciplines, in order to then reach a more qualitative analysis of how they appear in basic knowledge and specific skills.

For the analysis we have considered disciplines of a technological nature in the curriculum of the ESO and baccalaureate of the LOMLOE: “Digitalization”, “Technology”, “Technology and Digitalization”, and “Technology and Engineering I and II”. In the case of the disciplines Technology and Engineering I and II, it is taught in two courses, but the description of the discipline is made in a single block. Figure 4 shows the distribution of the most frequent references to climate change and sustainable development by discipline. It can be seen how the references to climate change through keywords in Digitalization are minimal, with only one reference to sustainability. In the case of Technology, there are a total of 10 references where sustainability is clearly highlighted. In the other two disciplines, Technology and Technology and Digitalization, there are a total of 12 indirect references to climate change. In all of these, we clearly see how the technology disciplines of the curriculum are intended to be directed towards the promotion of environmental awareness and the need to develop sustainable technologies.
4.3. Climate Change and Sustainable Development in Technology Disciplines

The curriculum of the LOMLOE is intended to be directed towards the promotion of environmental awareness and the need to develop sustainable technologies. In addition, in the basic knowledge and specific skills of the disciplines Technology and Engineering I and II, it is taught in two courses, but the evaluation criteria for each of the corresponding knowledge areas are defined, the latter being the evaluation criteria for each of the corresponding knowledge areas.

4.3.1. Technology and Digitalization

This discipline is the one that is implemented in the first courses of ESO. It encompasses subjects from the definition of the technological process as a solution seeker, to the use of digital technologies both for development and for communication. In addition, it aims to teach students to use technology as a tool to promote creativity, cooperation, and entrepreneurship. It should be noted that the ethical dimension of technology has been incorporated, highlighting both its social and environmental impact and the importance of having sustainable development that meets the SDGs.

The basic knowledge is organized into five blocks. The first four are dedicated to learning methodologies to address technological problems, find a solution and be able to expose and defend them. It is worth highlighting the fifth block, called “Sustainable Technology”. This block is focused on the necessary knowledge for the development of sustainable technology projects incorporating the ethical point of view, especially in the resolution of ecosocial problems. Thus, the analysis of the obsolescence of technological products, their environmental impact, and the need to incorporate a critical assessment of technological development in order to achieve the SDGs established in the 2030 Agenda are included.

The discipline of Technology and Digitalization has seven specific skills. The specific skills that refer to climate change and sustainable development are one, two, three and seven. Specific skill seven is the one that is most linked to the impact of climate change and sustainability. It is focused on the student having a responsible and ethical use of technology and being able to assess its impact on society and the environment. Thus, evaluation criterion 7.1 considers the students’ skills in recognizing the contributions and repercussions of technological activity, both in society and in environmental sustainability. In addition, the student must identify how emerging technologies can help to reduce environmental impact through ethical and responsible use (evaluation criterion 7.2). Specific skill two mentions the need for students to develop attitudes that help them to have sustainability criteria in the forecast of resources and to consider the balance between economic growth and environmental well-being. This competition has a structure similar to SDG 13 “Climate Action”, where sustainable solutions must be sought and cooperation encouraged to address the risks of climate change at a global level. It should be noted that, in its evaluation criteria, the search for sustainable solutions must be considered (evaluation criterion 2.1) through individual or group planning cooperatively and collaboratively (evaluation criterion 2.2). In skills one and three, very brief reference is made to sustainability and the environmental impact of technologies, as well as the need to analyse the environmental consequences of product development.
4.3.2. Digitalization

As can be seen in Figure 4, in the Digitalization discipline neither climate change nor sustainable development is mentioned. There is some review of the eco-sociable development of digital technologies (Evaluation Criterion 4.4) or sustainable digitalization (Basic Knowledge, Critical Digital Citizenship), but it does not refer to the impact of digital technologies on the planet’s ecosystem.

4.3.3. Technology

The description of the Technology discipline in the LOMLOE curriculum does not include direct references to climate change, but it does indirectly mention the negative impact of technological development on our planet and, in turn, the potential use of technology to address the Sustainable Development Goals. Thus, it is intended that the student directly understands how sustainability has to be present from the first moment of the design of a product: from the selection of materials to the definition of manufacturing processes, to the use of intelligent control systems for the optimization of resources. In addition, direct mention is made of the negative impact that technological development can have as a cause of climate change, such as transportation, energy-inefficient buildings, and the production of industrial products with scheduled expiration.

As in the case of Technology and Digitalization, a block of basic knowledge called “Sustainable Technology” is included. This block includes the necessary knowledge to apply sustainability and accessibility criteria in the design, use, and selection of materials, as well as in the design of the processes, to produce the technological product.

The discipline of Technology has six specific skills. The only skills that indirectly refer to climate change and sustainable development are two: specific skill two, and specific skill six. Assessment criterion 2.1 focuses on the students’ ability to apply ethical criteria and co-responsibility in the design of a technological product, considering the evolution and forecast of its life cycle. Criterion 6.1 considers the ability of students in the application of sustainability criteria from a selection of materials, as well as in the production processes. Lastly, criterion 6.2 assesses the ability of students to search for architectural and transportation solutions that mitigate their impact on the planet.

4.3.4. Technology and Engineering I and II

Technology and Engineering I and II is a specific option discipline that is offered in both courses of the Bachelor of Science and Technology. A description of the discipline and skills to be acquired during this stage is common. However, the basic knowledge and the criteria for assessing the scope of the skills are different depending on whether the course is in first or second year of baccalaureate, I or II, respectively. These two disciplines represent the continuity of ESO disciplines, such as Technology or Technology and Digitalization, but direct the discipline towards technological creations.

The discipline is articulated in six blocks. Similarly to the previous disciplines, a specific block of knowledge called “Sustainable Technology” is defined. This block in the first course includes basic knowledge such as that associated with energy systems and markets, emphasizing sustainable energy consumption. Furthermore, it focuses on training students in renewable energy, energy efficiency, and sustainability. However, in the second year of baccalaureate, the discipline is focused on the social and environmental impact of technologies from the point of view of ecosocial sustainability.

Specific skills one, three, four and five do not allude to climate change or sustainable development. Thus, only specific skills two and six refer to climate change and sustainable development.

Specific skill two is related to the abilities of the students in the selection of the appropriate materials for the manufacture of quality products and the preparation of studies on their environmental impact. In the first course, the evaluation criterion 2.2 specifies that students must know how to select materials according to sustainability criteria. Evaluation criterion 2.3 complements it by adding the need to apply technical
sustainability criteria in the manufacture of models or prototypes. In the case of the second year, it is still maintained as an evaluation criterion that sustainability criteria be taken into account in the selection of materials (criterion 2.1), and it is added that students must be able to write technical reports on environmental impact (criterion 2.2).

Specific skill six focuses on the ability to analyse and understand the consumption and energy efficiency of technologies for responsible and sustainable use. This is how energy generation, transport, distribution, or supply systems are addressed. Thus, in the first course, the students’ abilities to determine the energy efficiency of facilities (assessment criterion 6.1) are evaluated, while in the second course the students’ ability to analyse engineering systems following criteria of social responsibility and sustainability is evaluated (evaluation criterion 6.1).

5. Discussion

The Discussion section aims to delve into the findings of this study and provide a comprehensive analysis of the prevalence of climate change and sustainable development, through the SDGs, in the curriculum of the compulsory secondary education and baccalaureate in the new education framework in Spain (LOMLOE). This analysis is followed by a comparison of their application between different legislative frameworks (LOMCE-LOMLOE), and the distribution of these topics within technology disciplines. The aim is to open the discussion on how climate change and sustainable development are integrated into the educational framework and the newly opened challenges to the teaching community.

5.1. Climate Change and SDGs in ESO and Baccalaureate Curriculum of LOMLOE

This study highlights the favourable contribution of the new educational policies in Spain towards raising awareness among future generations about the need to mitigate climate change and promote sustainable development. In the same sense, Correa-Gonzalez, Lopez-Diez, Diaz-Pacheco, and Martin-Raya (2023) argue that “Climate change has become a global challenge that must be faced in a cross-cutting manner from multiple fields and involving all citizens” [36]. The new Organic Law for the Modification of the Education Law (LOMLOE) reflects this understanding by explicitly mentioning “climate change” in significant sections, such as the general objectives for the baccalaureate (objective o) and adult education (objective i). Furthermore, the correlation between sustainable development and the fight against climate change is clearly stated in the definition of the citizen skill (CC4) of the baccalaureate, establishing a link between promoting ethical and ecologically responsible activities and habits. The integration of sustainable development into the new curriculum bridges the gap between training in sustainable entrepreneurship [7] and ESO and baccalaureate education in Spain. It promotes awareness among future generations about the ethical implications of human actions on climate change, utilizing the Sustainable Development Goals (SDGs) as a transformative tool to shape the habits and behaviour of the youth.

From a general perspective, through an analysis of the curriculum content, references to climate change, sustainable development, and SDGs are found throughout the LOMLOE curriculum, from the definition of objectives and expected skills to the definition of disciplines across the different education levels. Remarkably, these references appear more frequently in the latter years of education, particularly in the baccalaureate, where students are defining their skills to access university degrees. This emphasis on climate change and sustainable development during this pivotal educational stage could be crucial in promoting ethical values and fostering a sense of concern about climate change alongside the professional aspirations of young individuals.
5.2. Climate Change and SDGs: From LOMCE to LOMLOE

Previous quantitative studies have revealed deficiencies in the presence of sustainability within the secondary education curriculum of LOMCE, particularly in the social and economic dimensions [16]. However, our study demonstrates a significant shift following the approval of LOMLOE, with climate change and SDGs now incorporated throughout the new education framework. Notably, LOMLOE stands out with a remarkable 600% increase in references to climate change and sustainable development compared to the previous Education Law, LOMCE. Today these topics are considered cross-cutting issues covered by a wide variety of disciplines, with over 300 references in the block of disciplines in total, and at least 200 references at baccalaureate level. The significance of these issues is further emphasized by the direct reference to climate change and sustainable development in the objectives of the baccalaureate, while they remain unchanged in the ESO curriculum.

In general, the new curriculum requirements aim to improve students’ capacity to respond to social, economic, and environmental changes due to the climate emergency. This approach promotes a more informed and discerning mindset among the younger generation, mitigating the influence of media sensationalism [34]. Thus, the new LOMLOE curricula for the ESO and baccalaureate establish new key competencies that directly address sustainable development and correlate with its social impact. However, it is important to note that the inclusion of terms such as SDGs, climate emergency, global challenges, circular economy, adaptation, and mitigation within an education law underscores the alignment with international environmental policies such as the “2030 Agenda” [8,37]. LOMCE did not include any of these terms, as it was approved prior to all of these international agreements.

5.3. Climate Change and SDGs within Technology Disciplines

While the controversy surrounding the approval of LOMLOE primarily centred on the legal framework and educational practices [25,26], our study reveals a significant shift in the perception of technology education as a catalyst for a more sustainable society and economy. A comparison between LOMCE and LOMLOE shows a similarity in the number of technology disciplines, but LOMLOE places greater emphasis on raising awareness about the environmental impact of technological development. For example, both the ESO and baccalaureate have undergone redefinition in terms of technology disciplines, introducing a common and traversal knowledge block named “Sustainable Technology” that aligns with the SDGs of the 2030 Agenda [8]. This knowledge block aims to educate students on concepts of sustainability and respect for the environment, from the first years of ESO to the final years of the baccalaureate, in the development and use of technologies.

Evaluation criteria and expected achievable skills are strongly correlated with the principles of sustainability and sustainable development. For example, LOMLOE promotes and encourages the assessment of students’ awareness regarding the environmental impact of technology development and the ethical responsibilities associated with its use and consumption. Consequently, the evaluation criteria encompass considerations of how students integrate sustainability into their solutions, including the assessment of product life cycle and production pollution. In that vein, the new legislation aligns with recent recommendations for achieving a sustainable future [7,31] by the integration of sustainable entrepreneurship and education in technology, ultimately paving the way for more sustainable markets and society.
5.4. Impact on Educational Practices and Policies

The implications of the results can have a national and international impact on policy-making processes, on improving pedagogical approaches in multiple contexts, and on improving the quality of the teaching–learning process. Revealing the emphasis given to climate issues and the goals of sustainable development in Spain will allow other countries to be able to use this innovative approach as an example, replicating the initiative. This innovative approach aligns with the international effort to develop school curricula that meet the demands of the 21st century [19]. For instance, initiatives like the one in the Netherlands, where a technology curriculum was developed from its initial stages through public consultation [20], can provide a pathway for Spanish educators to follow.

Aligned with the same principles, educational institutions will be able to operationalize initiatives that implement these with greater urgency and according to the new guidelines, due to the imperative nature of the legislative texts. In this way, the improvement of the quality of the teaching and learning processes will occur faster and more effectively. To effectively integrate the Sustainable Development Goals (SDGs) and climate change into the teaching of technology in secondary and baccalaureate schools, it is crucial to create educational environments that align with new national and international demands, following the action plans of the European Union. International collaboration programs such as Erasmus+ [38] and eTwinning [39] will play a key role in the formation of a new generation in Europe with a critical and proactive attitude towards seeking technological solutions to address the challenges of the climate crisis that they will face as adults.

6. Conclusions

In summary, the new legislative framework plays a significant role in educational innovation concerning the internationalization of educational settings. This is because the new educational legislation of LOMLOE is aligned with the European educational demands and the Millennium Development Goals established by the UN to address climate change, as we discovered in this research.

The integration of cross-cutting issues, such as climate change and sustainable development, across different disciplines will enable students to develop a comprehensive understanding of these issues, leading to a more sustainable and responsible future. Although these changes present a challenge for teachers [40,41], they also offer an opportunity to instill a sense of responsibility and commitment to the environment in future generations, which, in turn, will improve human actions and the future quality of life on the planet.

As sustainability, sustainable development, responsible consumption, and environmental impact are inherently linked to technological advancements, they are expected to become prominent themes in all kinds of learning contexts, especially in formal education. This study reveals the clear positive contribution of the new educational policies in Spain towards the formation of generations aware of the need to address climate change and their contribution to sustainable development, particularly in the curriculum redesign of the technology disciplines and in the training of future sustainable entrepreneurs.

To assess the effectiveness of incorporating SDGs and climate change into the technology disciplines of LOMLOE, additional studies are required. These studies should focus on various aspects, such as examining how well the new skills and competencies acquired by students translate into practical application when they enter the labour market. Furthermore, it is crucial to investigate the good practices that have emerged because of the legislative changes and determine how these practices can effectively combat climate change. Through these studies, we can gain valuable insights into the impact and outcomes of integrating sustainability and climate-related concepts into technology education, enabling us to refine and improve future educational approaches in this area.

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