

Review

A Systematic Review of Curriculum Sustainability at University: A Key Challenge for Improving the Professional Development of Teachers of the Future

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Abstract: This article presents a systematic literature review on curriculum sustainability in the initial education of primary school teachers. It analyses aspects related to the methodologies, keywords, geographical area, scope, theoretical frameworks of reference and main existing lines of research obtained from 38 documents between 2015 and 2021. Some research questions were as follows: What methodologies does it relate to? Are there elements that facilitate or hinder the development of curricular sustainability? What impact are programmes developing curricular sustainability having? Some of the results were as follows: (a) most of the documents analysed were published in Europe; (b) the main theme was the promotion of a committed and collective education; (c) approaches have to be based on sustainability competencies; (d) there was a lack of knowledge about sustainability competencies, a lack of training in education for sustainable development (ESD), and a lack of systemic and creative thinking; and (e) there is a need for ESD training to enhance knowledge and to develop sustainability competencies. In conclusion, the priority is to develop interdisciplinary, holistic and active methodology-based programmes that integrate deep changes throughout education. Study programmes should be modified in order to have a positive impact on the development of ESD.

Keywords: preservice teacher education; learning environment; curriculum; sustainability competencies; education for sustainable development



Citation: Lorente-Echeverría, S.; Murillo-Pardo, B.; Canales-Lacruz, I. A Systematic Review of Curriculum Sustainability at University: A Key Challenge for Improving the Professional Development of Teachers of the Future. *Educ. Sci.* **2022**, *12*, 753. <https://doi.org/10.3390/educsci12110753>

Academic Editor: Andras Balogh

Received: 30 September 2022

Accepted: 21 October 2022

Published: 27 October 2022

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1. Introduction

The relationship between humans and nature is often measured in terms of productivity and profit rather than in terms of well-being, equal rights and opportunities, and care for the planet [1]. Therefore, education is the tool for reorienting life towards a sustainable world [2]. We need an education that provides teachers who have the capacity to go beyond the fragmented view that dominates schools today and move towards holistic and systemic thinking [3].

Sustainability assumes a social and environmental reorientation towards a sustainable future [4]. It involves aiming for the integration of sustainability in all spheres of life, with education as one of the most important points [5]. The integration of sustainability has to do with a change in education towards the resolution of complex problems [6] as part of a process that could be called curricular sustainability, which requires a leap towards systems thinking, interdisciplinarity or multidisciplinary in higher education [4].

UNESCO stresses the importance of including curriculum sustainability in universities, prioritising ESD in initial teacher education [7]. The involvement of teachers in the process of sustainability is essential, as they are the main axis of society and are responsible for training the future leaders of society [5,8,9].

However, although evidence points to the need to include curricular sustainability in higher education [10], study program, campus and learning strategies still do not go hand in hand with sustainability [4]. While sustainability promotes thinking, action and

transformative learning, higher education continues with a transmissive approach and magistral lectures [11].

For some time now, universities have begun to promote the integration of ESD in all areas: teaching, research and management [9,12,13]. Although this reorientation of the curriculum towards sustainability is a slow process with little successful progress [14,15], several institutions are offering inspiration and guidance to universities to accelerate education for sustainable development (ESD) [16].

Approaches in the university context remain traditional and mechanistic [7], far removed from holistic and integrated curricula [8]. For this reason, numerous authors [9–13] agreed on the need to do away with a disciplinary vision that characterises universities and renews the current educational structures, adjusting them to the demands of society and professional development.

The direction that the incorporation of sustainability into curricula needs to take is about changing attitudes to focus on sustainable behaviours that offer students more effective action [17]. UNESCO [6] highlights ESD as one of the best strategies for making university curricula sustainable. ESD is the best response to the planet's urgent challenges since it promotes changes in knowledge, skills and values [4]. Learning about sustainability is approached from competency-based learning and curricular principles or criteria that guide the teaching–learning process: interdisciplinarity; real, experiential and transformative learning; participatory approaches; etc. [17–19].

Considering that education is a key tool for achieving ESD [20], teacher education must yield to change and be oriented towards ESD [21]. There are numerous examples of programmes that have integrated ESD [1,20,22–24]. However, teacher preparation is still insufficient [21]. Thus, there is a need to transform and connect content and teaching methods to achieve ESD. For this reason, the Priority Action Area of UNESCO's Global Action Programme is oriented towards the development of teachers' capacities with the aim of integrating ESD into initial and in-service teacher education [20]. For this education in ESD to take place, teachers need to acquire key sustainability competencies (systems, anticipatory and normative thinking) that enable the development of innovative teaching and learning actions [16].

The type of ESD to be developed is mainly characterised by being formulated by and for the student and is focused on their teaching and learning [21]. The pedagogical strategies followed should promote the creation of students who are active in the face of social transformation [21,25]. The strategies that appear today as optimal for the development of ESD have to do with the inclusion of all students and involve learning through social action projects, case studies, service-learning for society and collaborative learning [26].

Therefore, initial teacher education needs to create professionals that are capable of implementing ESD in schools [13,14]. It is essential to create optimal learning environments in which to develop this education based on critical thinking, multi-stakeholder participation, interdisciplinarity and transdisciplinarity, incorporating diverse learning contexts [6,16].

For ESD to be developed in initial teacher education, it does not suffice to only convey sustainability-related issues; it is a matter of going a step further and working on the basis of professional competencies in sustainability [6,17].

The aim must be to ensure that people do not stop at knowing the problems, but are also able to collaborate and be part of the solutions and opportunities for change [18,19]. Compulsory education is a key moment for the acquisition of knowledge, attitudes and values that bring about changes towards a sustainable way of life for individuals. Therefore, integrating ESD into initial teacher education is essential, as teachers are a reference point for society, and their actions can generate sustainable behaviour in future generations and empower them to take action [9,17].

The Sustainable Development Goals (SDGs) emerged as a set of goals that are determined to balance the three dimensions of sustainable development—namely, economic, social and environmental—by 2030. The meaning of the SDGs is based on understanding them from an integrated approach; all goals depend on each other and must be pursued

together, and therefore, progress on some of them will also determine progress on others [3]. The SDGs lend a hand to the development of ESD [7], which is understood as a process of integrating ideals and principles that prepare future citizens so that they are capable of finding solutions to problems related to the sustainability of the planet [12]. Education has an indispensable role within the SDGs, being a stand-alone goal (SDG4) and linked to almost all other SDGs [16].

Physical education didactics is beginning to promote pedagogical models oriented towards ESD [27], although for the moment, there is still no scientific evidence on this [1]. Given this lack of evidence, the state of play of the present study had to be modified, as it was initially oriented towards ESD for future teachers of physical education. Given this circumstance, the subject of study focused on how to integrate curriculum sustainability into initial teacher education [28].

A literature review is based on the search for and analysis of all existing information on the subject of study. However, given the lack of such information, this research was forced to modify the subject of study. Therefore, it was generalised to teacher education without specifying any area. The research focused on identifying everything that has been discovered thus far on the subject in terms of the main research, authors, results, theories and hypotheses, methodologies and instruments used in relation to the subject of study [29].

Thus, the main objective was to identify and analyse the main studies that were developed on curriculum sustainability in the initial education of primary school teachers. In addition, two specific objectives were established based on (I) identifying, through the existing literature, aspects related to the nature and methodology, keywords, geographical area, journals, scope and participants, and (II) synthesising, through the existing literature, aspects related to this training: the theoretical frameworks of reference, main existing lines of research, methodologies and strategies used, results obtained and main conclusions drawn.

Based on the objectives, the following research questions were considered. In relation to the first specific objective: (I) In which geographical areas are curricular sustainability mainly promoted? (II) What methodologies does it relate to? In relation to the second specific objective: (III) What are the main themes of study that curricular sustainability addresses? (IV) Are there elements that facilitate or hinder the development of curricular sustainability? (V) What impact are programmes developing curricular sustainability having?

2. Materials and Methods

This article presents the results of a systematic literature review that followed the rules of scientific rigor in empirical research: objectivity, systematization and replicability of the results [29,30]; the review investigated curriculum sustainability in the initial education of primary school teachers. Research into the new challenges that should be carried out in higher education to achieve ESD was based on the content extracted from the documents published on the subject of study between 2015 and 2021. It should be noted that this research was part of a doctoral thesis that aims to introduce curriculum sustainability through an intervention programme in the education of physical education teachers.

The documents were located through databases in the field of education: Education Resources Information Center (ERIC), Web of Science (WOS) and Scopus. The documents in Spanish were located through the Dialnet database. Doctoral theses were located through Tesis Doctorales en Red (TDX) and the ProQuest Dissertations & Theses Database (PQDT).

The search strategy began with the organisation of a series of terms related to curriculum sustainability and the didactics of physical education. However, as mentioned above, due to the lack of results, it was decided to generalise towards the initial education of primary school teachers without focusing on any specific area. For this purpose, an initial search was carried out in Spanish and English in the European Education Thesaurus (ERIC) and in the UNESCO Education Thesaurus. We searched for terms such as “teacher competencies”, “teacher education” and “curriculum sustainability”. Based on these and other keywords, two search strategies were developed for the different databases, both in

English and Spanish (Table 1). In both search strategies, the criteria were limited to the title, abstract and keywords so that the largest number of documents from each database could be collected.

Table 1. Search strategy, list of databases consulted, and documents located and analysed.

Search Strategy						
ROUTE 1	English	[("Pre-service teacher education" OR "teacher competencies") AND ("Sustainability in the curriculum" OR "education for sustainable development")]				
	Spanish	[("Estudiantes en formación de maestros" OR "competencias docentes") AND ("Sostenibilización curricular" OR "educación para el desarrollo sostenible")]				
ROUTE 2	English	[[("Pre-service teacher education" OR "teacher competencies") AND ("Life skills" OR "Integrated curriculum")) AND (("Sustainability in the curriculum" OR "Education for sustainable development"))]				
	Spanish	[[("Estudiantes en formación de maestros" OR "competencias docentes") AND ("Habilidades para la vida" OR "currículum integrado")) AND ("sostenibilización curricular" OR "Educación para el desarrollo sostenible")]				
Databases	Search equations used in ENGLISH	Located	Analysed	Search equations used in SPANISH	Located	Analysed
SCOPUS	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	138	22	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	0	0
	(TITLE-ABS-KEY (ROUTE 2)	2	1	(TITLE-ABS-KEY (ROUTE 2)	0	0
DIALNET	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	1	1	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	0	0
	(TITLE-ABS-KEY (ROUTE 2)	0	0	(TITLE-ABS-KEY (ROUTE 2)	0	0
WOS	(ROUTE 1) Refined by: PUBLICATION YEARS: (2021 OR 2020 OR 2019 OR 2018 OR 2017 OR 2016 OR 2015)	11	1	(ROUTE 1) Refined by: PUBLICATION YEARS: (2021 OR 2020 OR 2019 OR 2018 OR 2017 OR 2016 OR 2015)	0	0
	(ROUTE 2) Refined by: PUBLICATION YEARS: (2021 OR 2020 OR 2019 OR 2018 OR 2017 OR 2016 OR 2015)	0	0	(ROUTE 2) Refined by: PUBLICATION YEARS: (2021 OR 2020 OR 2019 OR 2018 OR 2017 OR 2016 OR 2015)	0	0
ERIC	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	23	16	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	0	0
	(TITLE-ABS-KEY (ROUTE 2)	0	0	(TITLE-ABS-KEY (ROUTE 2)	0	0
SCIELO	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	0	0	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	0	0
	(TITLE-ABS-KEY (ROUTE 2)	0	0	(TITLE-ABS-KEY (ROUTE 2)	0	0
TDX	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	3	2	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	2	0
	(TITLE-ABS-KEY (ROUTE 2)	0	0	(TITLE-ABS-KEY (ROUTE 2)	1	0
PQDT	(ROUTE 1) and PDN (≥20150101) and PDN (≤20210101)	4	2	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	0	0
	(ROUTE 2) and PDN (≥20150101) and PDN (≤20210101)	4	0	(TITLE-ABS-KEY (ROUTE 2)	0	0
Dart-Europe Thesis	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	0	0	(TITLE-ABS-KEY (ROUTE 1) AND (LIMIT-TO 2021-2015)	0	0
	(TITLE-ABS-KEY (ROUTE 2)	0	0	(TITLE-ABS-KEY (ROUTE 2)	0	0
TOTAL = 186				TOTAL = 3		

Source: compiled by authors.

After locating the documents, those to be analysed were identified. To do so, a series of criteria were checked:

1. All duplicated documents between the different databases were eliminated ($n = 17$).
2. All those that did not refer to the subject of the present research were eliminated ($n = 130$).
3. Based on a review of the summary of each document, those that were not clearly useful for the research were eliminated ($n = 22$).

This process was carried out through consensus between two researchers. Each of them reviewed the material independently and then pooled it, establishing a consensus between those articles that would be accepted and those that would be rejected.

Once this process was completed, and according to the search and selection criteria, a total of 38 documents of different types were obtained. In order to analyse them, an outline of the elements of the research on which the content of the studies would be analysed was established. These included the journal name, nature of the document, keywords, results, conclusions, main themes, theoretical frameworks or reference models, methodologies, geographical context, scope of the research, recipients and stakeholders, other relevant considerations and additional literature.

With the documents finally selected ($n = 38$), we proceeded to read the sections on the theoretical framework, results and conclusions, as these were the sections with the most content in all the studies. First, with regard to the theoretical framework, 20% of the sample was read in order to establish some general themes that could be established as common to the rest of the documents. From there, nine items were extracted that served as points of reference for the analysis of the rest of the research, and any other theme that appeared and could be relevant to the research could be added (Table 1).

Second, an individualised analysis of the results and conclusions was carried out for each of the documents in the sample. After a second reading of these two sections, we proceeded to establish links or relationships between the content of all of them. In this way, the information gathered from the main findings and conclusions was organised around three areas of knowledge: "ESD development", "ESD education" and "Impact of ESD studies".

In order to ensure the reliability of the whole process, the selection, classification and analysis of all data units were carried out independently by three researchers and authors of this article. The work of locating and analysing all the documentation was carried out from February to June 2021.

3. Results

The results were organised into two main sections, corresponding to the two specific objectives.

3.1. Results Related to the First Specific Objective

3.1.1. Nature and Methodology of the Documents Analysed

Most of the documents analysed were academic articles (37 articles) with different methodologies. On the one hand, there were 20 articles that used a qualitative methodology and seven that used a quantitative methodology. In addition, ten articles that used a mixed methodology were extracted. On the other hand, four doctoral theses were analysed with varied methodologies: one qualitative, one quantitative and two with a mixed methodology.

In addition to the nature and methodology of the documents, the instruments used in the studies analysed were identified. In most of the articles, several instruments were used, although most of them were questionnaires with open-ended questions (24 articles), ad hoc interviews (24 articles) and closed-ended questionnaires (11 articles) (Table 2). Eight literature reviews were also analysed.

Table 2. Methodology and instruments used.

Nature and Methodology			
	Qualitative	Quantitative	Mixed
Articles	20	7	7
Theses	1	1	2
Instruments			
	Articles	Theses	
Literature review	8	1	
Closed-ended questionnaires	10	1	
Open-ended questionnaires	12		
Ad hoc interviews	10	2	
Photos/videos/photo with voice	3		
Field notes	1		
Experiential mapping		1	
Case study		1	

Source: compiled by authors.

3.1.2. Journals in which the Analysed Papers Were Published

The journals *Sustainability* (7 articles) and *International Journal of Sustainability in Higher Education* (6 articles) published the largest number of articles on the education of future teachers in ESD. On the other hand, three articles were found in the *Journal of Teacher Education for Sustainability* and the *Environmental Education Research* journal, and two articles were identified in the *Discourse and Communication for Sustainable Education* journal, the *International Journal of Early Childhood* and the *Journal of Cleaner Production*. Finally, only one article on the subject of study was found in each of 12 other journals (Table 3).

Table 3. Journal in which papers on the subject of study were published.

Academic Journals	Number of Articles
<i>Sustainability</i> (environmental studies, green and sustainable science and technology, environmental sciences)	7
<i>International Journal of Sustainability in Higher Education</i> (education and educational research, green and sustainable science and technology)	6
<i>Journal of Teacher Education for Sustainability</i> (social sciences—education)	3
<i>Environmental Education Research</i> (social sciences—education)	3
<i>Discourse and Communication for Sustainable Education</i> (social sciences—education)	2
<i>International Journal of Early Childhood</i> (education and educational research)	2
<i>Journal of Cleaner Production</i> (green and sustainable science and technology, engineering, environmental sciences)	2
<i>Internacional de educación para la Justicia Social</i> (social sciences—education—sociology and political science)	1
<i>Journal of Education and Learning</i> (social sciences—education)	1
<i>Pakistan Journal of Distance & Online Learning</i> (social sciences—education)	1
<i>Journal of Education for Sustainable Development</i> (environmental education, economics, communications, education, social sciences, humanities)	1

Table 3. *Cont.*

Academic Journals	Number of Articles
<i>The Journal of Environmental Education</i> (environmental science, sustainability education)	1
<i>World Journal of Education</i> (education, teaching, learning)	1
<i>ProQuest Dissertations Publishing</i> (social sciences, science and technology)	1
<i>International Journal of Sustainable Development & World Ecology</i> (environmental science, social sciences)	1
<i>Teaching and Teacher Education</i> (social sciences—education)	1
<i>Curriculum Perspective</i> (social sciences—education)	1
<i>Knowledge Cultures</i> (social sciences: cultural studies, education, law, library and information sciences, sociology and political science)	1
<i>Teacher Development</i> (social sciences—education)	1

Source: compiled by authors.

3.1.3. Keywords

The keywords extracted from the sample analysis were organised around the words that were used for the search route (Figure 1). This route was mainly composed of four groups of words.



Figure 1. Keywords most mentioned in the sample. Source: compiled by authors.

The term “future teachers of education”, together with others of similar meaning, had the highest incidence in the studies identified. In the different articles, we found the following: teacher education (25 articles), pre-service teachers (3 articles), pre-school teacher, teacher, in-service teachers, teacher education and teacher competencies.

Second, “education for sustainable development (ESD)” was the term that appeared most frequently in the whole sample (35 articles), although other terms, such as sustainability (6 articles), sustainable development (5 articles), environmental education (5 articles), environment, teacher education for sustainability and didactic approaches to education for sustainable development, were also used.

Third, “teacher competencies” was another of the terms that were most frequently used in the articles analysed. Terms such as competencies (8 articles), sustainability competencies (4 articles), interdisciplinary competencies and research competencies were found.

Fourth, terms such as “curriculum sustainability, integrated curriculum” were taken into account, from which others were extracted, such as curriculum sustainability, curriculum framework, curriculum revision and curriculum.

3.1.4. Geographical Area

From the content extracted from all the documents, the geographical areas that contributed the most to the subject of study were discovered. Table 4 shows that the sample number (38 articles) did not coincide with the result of geographical contexts obtained. This was due to the fact that in numerous studies, there were various contexts in which they were developed.

Table 4. Geographical areas of the sample extracted.

	Articles	Theses	
	Germany	2	
	Albania	1	
	Austria	1	
	Belgium	1	
	Belarus	1	
	Czech Republic	1	
	Croatia	1	
	Slovakia	1	
	Slovenia	1	
	Spain	6	
Europe	Finland	1	
	Greece	3	
	Kosovo	1	
	Norway	1	
	Netherlands	1	
	Poland	1	
	Portugal	1	
	Romania	1	
	Sweden	3	
	Turkey	1	
	Ukraine	1	
		Usa	3
	America	Ecuador	1
	India	2	
Asia	Pakistan	2	
	Malaysia	1	
	Korea	1	
Oceania	Australia	3	

Source: compiled by authors.

Analysing the results obtained, and taking into account scientific articles and doctoral theses, the largest number of publications on the subject of study was from Europe (31 articles). These publications were widely distributed throughout the European continent, with Spain (6 articles) being one of the countries where most research and publications on the subject were carried out, followed by Greece (4 articles) and Sweden (4 articles). On the other hand, on the Asian continent (6 articles), countries such as India (2 articles) and Pakistan (2 articles) had a greater impact. Finally, the studies in the USA (3 articles) on the American continent and Australia (3 articles) on the Oceanic continent were also noteworthy.

3.1.5. Scope of Research

The scope of the research was analysed in terms of whether the studies were local, national or international. A study was understood as local when the study was carried out in a single university and therefore in a single country, national when it involved two or more universities within the same country or city, and international when it was carried out in two or more universities in different countries.

As can be seen in Table 5, most of the studies were local in scope (13 articles and 3 theses). On the other hand, 12 documents were analysed (10 articles and 1 thesis) in which a national scope was developed, generally in two, three or four universities. Finally, regarding an international scope, four articles were obtained, of which one of them [31] was carried out in ten different universities across Europe.

Table 5. Scope of the sample.

	Articles	Theses
Local	13	3
National	10	1
International	4	

Source: compiled by authors.

3.1.6. Participants and Stakeholders

In all the articles in the review, we analysed those who acted as participants and those who acted as stakeholders in the different types of studies. It should be noted that participants were understood as those persons or groups of persons towards whom the subject of study of the research or the intervention carried out was directed. On the other hand, the stakeholders were considered those whose role was to contribute to achieving the objective of the study.

From the analysis we carried out, it was found that the main participants in most of the studies identified were pre-service teachers, i.e., future educators (23 articles). However, articles were also found in which the participants were pupils (4 articles) and in-service teachers (2 articles). On the other hand, regarding the stakeholders, we found that the main ones were university teachers (6 articles), who were trainers of future trainers, as they acted as organisers and driving forces, and were in charge of developing the research and influencing their university students. On the other hand, stakeholders again included in-service teachers (2 articles), pre-service teachers (1 article) [32], and an interdisciplinary team consisting of a scientist, an educator and experts on the subject of study [25] (Table 6).

3.2. Results Related to the Second Specific Objective

Based on the most general aspects, the most relevant characteristics were studied, such as the main themes addressed in the justification of the studies, the results and conclusions obtained in each research, and the theoretical frameworks of reference.

Table 6. Participants and stakeholders.

	Participants	Stakeholders
Pre-service teachers	23	1
In-service teachers	2	2
University teaching staff		6
Students (primary education)	2	
Interdisciplinary team		1

Source: compiled by authors.

3.2.1. Main Themes according to the Studies Analysed

Based on the literature review, a common framework was established for all the studies analysed according to the repeated incidence of the different and most relevant themes of study addressed in the research analysed (Table 7).

Table 7. Main themes addressed.

Main Themes Addressed	Number of Articles in the Sample that Mention It
1. The responsibility to promote a committed and collective education from the university, with the participation of all actors and agents being key.	24
2. Creating competent teachers with the capacity to critically act and shift towards ESD and being a role model for the improvement of education and society.	24
3. Making the interdisciplinary approach happen in the university curriculum with evidence on teaching and learning methodologies and pedagogical approaches that foster ESD.	21
4. Integrating new opportunities and environments that enhance the relationship of specific content with ESD in real contexts for competent, meaningful and experiential learning.	19
5. Creating an enabling environment for the development, practice and assessment of the future teacher's ESD competencies.	23
6. Integrating global changes towards ESD at all stages of the educational process (pre-school, primary, secondary, vocational education, higher education).	18
7. Extending (in)formation, both theoretical and practical, for university teachers on how to integrate ESD.	20
8. Providing a holistic approach through processes that stimulate integrative thinking and practice, inclusion and management of the complex.	18
9. Developing further strategies and tools for evaluation and monitoring, both in the short term and in the medium-to-long term.	7
10. Pedagogical models of physical education that promote ESD.	0

Source: compiled by authors.

Among the most relevant elements identified in the studies analysed was the responsibility to promote a committed and collective education from the university, which was a theme mentioned in up to 24 papers from the entire sample [13,33,34]. Numerous authors [28,29,35,36] asserted that the future generation will be made up of people who are better prepared to face the challenges of sustainability, but all of this requires education that is committed to sustainable development. Chinedu et al. [35] asserted that while the education of pre-service teachers will contribute to change, success will depend on the professional development demonstrated by current in-service teachers. Popova et al. [37] highlighted the importance of working with in-service teachers, as they are the ones who best know the reality that the teachers of the future will face.

On the other hand, another of the most relevant themes had to do with creating competent teachers who are capable of acting, are critical in education for sustainable development and act as role models [29,38,39]. This involves teachers with skills, values,

attitudes and dispositions towards students that lead to both personal and social transformation [40,41]. Self-efficacy, which is defined as the confidence in oneself to solve a problem or carry out a task [42], is paramount in a teacher who is critical and is able to act on the challenges provided by learning. Malandrakis et al. [43] considered self-efficacy as an optimal tool to improve students' performance and motivation towards learning, as well as their commitment to achieving the goals they set for themselves.

Furthermore, it is important to highlight the importance of creating an enabling environment for the development of competencies in education for sustainable development that a future teacher should possess [16,44]. Authors such as Kang [45], Sterling [37] and Kalsoom and Qureshi [46] saw competencies as an essential component of ESD literacy. According to the Higher Education Academy (HEA), a competency profile has to be composed of a broad and balanced knowledge of sustainable development, problem-solving skills, creative and holistic thinking, self-reflection and interdisciplinarity, among others [47].

Finally, as mentioned above, physical education didactics has not yet identified pedagogical models that promote ESD [27], and thus, there is a lack of scientific evidence [1].

3.2.2. Main Findings and Conclusions of the Articles Reviewed

Based on the findings and conclusions analysed from the different documents, evidence was organised around three main areas: ESD development, ESD education and the impact of ESD-focused research (Figure 2). These were then organised into sub-areas that helped to understand and organise all the information gathered.

3.2.3. Progress of ESD: Facilitators, Challenges and Benchmarks

Taking into account the elements that facilitate the development of ESD, numerous authors [13,17,34,48,49] consider the development of ESD competencies of university teachers and students to be a priority. These competencies are based on interdisciplinarity, which will provide teachers with support in their educational practice [24]. Brand [50] called for the continuous development of specific ESD competencies and complementary competencies that foster greater interest and demand intercultural competence [49].

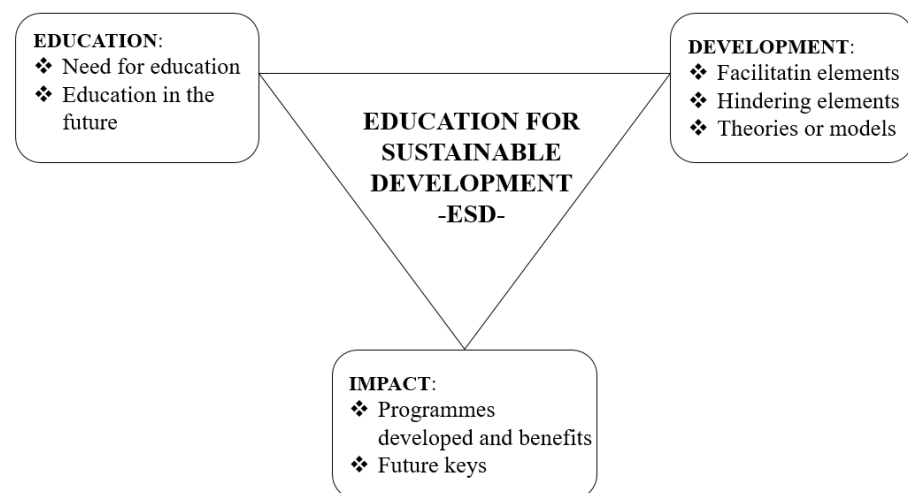


Figure 2. Results and conclusions of the sample. Source: compiled by authors.

Second, the importance lies in the approaches that are developed to enhance ESD. Authors such as Baena-Morales et al. [29], Evans et al. [44] and Hofman-Bergholm [51] called for systemic, holistic and integrated approaches that take into account a curriculum that includes and encompasses ESD as a whole, is interdisciplinary, and is based on active, experiential and reflective methodologies. Albareda-Tiana et al. [34] highlighted project-based learning as a useful methodology to enhance a positive relationship between sustainability and the development of ESD competencies. Problem-based learning is

another methodology mentioned as beneficial for promoting conceptual and practical aspects of ESD literacy. Esteve-Guirao et al. [52] considered this methodology as a three-dimensional contribution to sustainability and an interactive learning process, in addition to the facilities it offers from its development, as the performance of daily activities familiarises students with the subject and allows for a period of reflection and evaluation.

All these approaches and methodologies require a teaching professional to implement them. Evans et al. [44] reflected on what such a teacher should be like in terms of what characteristics they should possess to achieve this goal. Such an empowered professional with capacity, commitment and motivation; faces real challenges and problems; and who, as highlighted by [53], participates in projects. In short, a teacher who acts as an agent of change, has an affinity with ESD, has a critical attitude, has the ability to raise awareness among other professionals, has strong self-efficacy when teaching, and is passionate and enthusiastic about ESD [39,54].

Third, numerous authors [22–24] stressed the need for an evaluation of the work carried out in ESD, which involved critical reflection that provided clues about the work that was carried out, helped to learn from what has worked and is able to change what can be improved [55].

Finally, authors such as Alcalá del Olmo et al. [10] highlighted the university, higher education and, specifically, teacher education, as an optimal context and opportunity for the development of ESD as a place for change where experiential education can be promoted, leading to sustainable education where citizens who are close to reality and open to social conflicts are trained.

Taking into account the elements that hinder the development of ESD, Cebrián et al. [56] highlighted that there is a lack of knowledge of sustainability competencies on the part of pre-service teachers. They do not have the capacity to see sustainability in a holistic way via understanding its three dimensions [57]. For this reason, as Malandrakis et al. [43] pointed out, teacher students do not have the capacity to understand the complexity of issues related to sustainability. On the other hand, there is a lack of critical and creative thinking to visualise changes and achieve transformation and sustainable development [58].

Second, just as evaluation was previously seen as an element that could support the development of ESD, authors such as Evans et al. [44] and Evans and Ferreira [48] also highlighted the shortcomings of evaluation based on simple observations. There is a lack of reflective, critical and systematic evaluation in ESD [36,59] that can determine the effectiveness and sustainability of strategies, processes and programmes [41].

Other authors [41,60] highlighted that there is a lack of a transformative approach by people, pedagogy and education systems for the development of ESD. To date, there are many articles that enhanced ESD implementation. However, studies are now required that develop programmes in a systemic and interdisciplinary way for change to occur in a multifaceted and system-wide manner [59].

We need evidence-based processes, strategies and programmes to successfully meet the requirements of ESD [51,61]. Therefore, it is worth highlighting the importance of certain theoretical models in the development of ESD: social learning theory [54], as well as systems thinking and leadership theories [36,62]. The basis of these models has guided some of the studies analysed in this review [52,60].

In addition, some of the comprehensive models for professional development in initial teacher education were identified in this review, which showed a variety of ways they attempted to effect or achieve change for sustainability. The study by Årlemalm-Hagsér [63] showed how the Mainstreaming Sustainability Model [36] incorporated ESD into the entire pre-school teacher education programme, from management to instructional levels, and created possibilities for institutional change. These authors also offered ideas, strategies, examples and resources for others seeking to systematically implement ESD in higher education through a multi-level systems approach [36].

This model of sustainability integration is based on an extensive literature review of professional development models (collaborative resource development and adaptation

model, action research model and whole-of-system model) used in pre-service teacher education initiatives [36]. The model combined the characteristics of a participatory action research process with a whole-of-system approach in an effort to simultaneously initiate systemic change through deep and meaningful but flexible engagement with change agents within the system [31,41]. In the case of systemic change for sustainability, this means developing change agents' knowledge of ESD, conceptual skills in systems thinking, organisational change and leadership [56].

Elements such as critical reflection, identity reconstruction and critical awareness have become the driving forces for the development of ethical perspectives for the conceptualisation and development of fair curricula for sustainability. Along this line, the study by Makrakis [64] showed the "DeCoRe plus Model", which is a methodological approach that helps to move from theory to praxis. It is a model that has been developed in initial and permanent teacher education courses with the aim of incorporating sustainability into school curricula and syllabuses. In addition, it has been developed alongside two complementary trends: open education resources and open courseware. "DeCoRe plus" is the abbreviation for deconstruction–construction–reconstruction processes complemented by diagnostic evaluation, implementation and summative evaluation.

Several benefits are established from the development of such a model, such as the development of a transformative praxis that constantly involves the participant in a manner that translates theory and converts it into practical terms by taking into account the context and creating a sustainable and just society [64]. The theoretical foundation of the "DeCoRe plus" methodological approach is derived from critical social theory, critical pedagogy and postmodern conceptions of teaching, learning and curriculum.

The theories and models presented above are situated in a comprehensive framework of teacher competencies in ESD, which was alluded to by some authors [26,35,59], showing that they served as a basis for the design of educational provision in teacher education institutions. This broader framework for addressing competencies is supported by three common competency models describing educators' competencies: the Curriculum, Sustainable Development, Competencies and Teacher Education (CSCT) model [26], the Curriculum Environmentalisation of Higher Education (ACES) model [65] and the Learning for the Future: Competencies in Education for Sustainable Development (ECE) model [45]. All of them claim to have answered the question of teachers' competencies for implementing ESD.

3.2.4. Need for Education in ESD: What Should Education in ESD Look like in the Future?

Current literature consistently calls for the need for education to integrate ESD in the university context, as the lack of such education leads to clear insecurity on the part of teachers to move towards the implementation of sustainability [28,46,47].

Among the constant requirements to foster education, differentiation was made between the education required for prospective teachers and that required for university teachers or teacher educators. First, authors such as Alcalá del Olmo et al. [10] stated that there is difficulty in educating based on the content of the subjects as they are currently set out. For this reason, they call for continuous education through training activities, conferences and seminars that help to achieve higher competence.

On the other hand, there is also a lack of content in terms of the curricula of the teaching degree in line with the environmental and social reality, again a consequence of the lack of education in ESD [65]. García-González et al. [66] asserted that lifelong learning in sustainability could enhance the development of methodological strategies that help to train critical and committed citizens in sustainability. To this end, some authors developed courses and academic programmes in ESD [42,63], as well as strategies that help to address problems related to the reality and context in which learning takes place [67].

Chinedu and Wan-Mohamed [54] concluded that existing ESD programmes, courses and training strategies are not sufficient, and that the education is inadequate for future teachers. Along this line, there are authors such as Hofman-Bergholm [51] who claimed

that it is necessary for university teachers to acquire competencies in sustainability and motivation, as they are the basis for the learning and transformation of future teachers; they are the ones who must guarantee quality initial education.

Timm and Barth [47] asked three questions that help to specify where education should take place in order for future teachers and university teachers to become agents of change: what to teach—knowledge of pedagogical content in ESD, based on competency-based learning and following different paths to achieve the knowledge and skills needed to become autonomous; when and how to teach—an institutional teaching and learning approach through which learning objectives can be selected and their relationship to the content and methods to be developed. This approach can then be complemented by others that focus on a broader context and aim for wider dissemination and implementation; and where to teach—in-service education programmes at levels that are accessible to all prospective teachers, where ESD is integrated and not an additional burden.

The literature outlines what education in ESD should look like. For example, Chinedu and Wan-Mohamed [54] noted that programmes that develop ESD competencies should enhance mastery of ESD knowledge and understanding, develop teachers' capacities and adaptability to their own context, and be grounded on meaningful learning activities based on the principles of sustainable development. Kalsoom et al. [68] saw these programmes as an opportunity to collectively learn about sustainability and develop ESD-friendly behaviours and attitudes. On the other hand, García-González et al. [66] added that for an education programme to be positive, i.e., to lead to transformation, empowerment and sustainability, it must foster a holistic perception of ESD; be focused on active strategies, approaches and methodologies; and be based on the principles of ESD.

Furthermore, we must not forget that education in ESD must be flexible, with the capacity to adapt to the context, resources and reality in which it is developed [65]. It must be based on transformative learning situations [14], which empower students and give them a global understanding of the world. This requires an education that promotes critical thinking [37,53,60,64] and develops knowledge and skills [37,58,64,65].

3.2.5. The Impact of Research on ESD

The following highlights some of the programmes, courses and seminars identified in the articles analysed in this review, as well as their impacts.

The Continuing Professional Development (CPD) programme [31] is characterised by the development of key sustainability competencies, it is long-term and practice-oriented. Its benefits include the acquisition of knowledge in all three dimensions and its participants identify with systems thinking and learning close to the real world.

Another programme is the 4 Cs (personal, professional, social and structural) [35], which is a learning approach in initial teacher education in sustainability and is based on four forms of connection through personal, social, professional and structural (context) knowledge. The four forms of connection that describe how learning takes place, based on the connection to the real world, have consequences that are influenced by the absence or presence of these connections

ConSus [69] is a course based on key competencies (learning from the past, inspiring engagement with the present, exploring alternative futures, etc.) [61,70]. It is a programme that develops challenges according to learning experiences based on a holistic approach that helps to understand the complexity of sustainable development and involves different actors.

The Seminar on Sustainable Development [32] was a programme that enhanced the development and acquisition of sustainability competencies, as well as an exchange between university teachers of approaches, knowledge and didactic material developed in different countries.

From the different programmes, courses and seminars identified, some keys for the future, improvements and implementations can be deduced that can help to develop them in the long term. Redman [45] and Lasen [71] stated that the future of the actions or

programmes requires continuous, action-oriented professional learning and community partnerships. There is a need for long-term programmes and studies [63,72], as well as temporary reviews of their performance to help improve them [73].

4. Discussion

After analysing the literature on curriculum sustainability in the initial education of primary school teachers, a series of strategies were identified that served as the basis for organising this research.

From a general perspective, the nature of the material extracted from the present research was made known and was characterised by the fact that it was mainly made up of qualitative scientific articles. In terms of the main instruments, there was a great preponderance of the use of questionnaires, both closed and open-ended; interviews; and literature reviews. In addition, it was found that the most frequently used terms, depending on the field of study, were ESD, teacher education and curriculum sustainability, among others. According to the geographical areas where most of the work in the area of study was carried out, Europe stood out, in particular, Spain, Greece or Sweden; the United States from America and Australia from Oceania also featured prominently. Most of these were articulated around a local or national scope. In other words, studies were carried out in only one university or in several within the same country. Finally, the main target group of the studies analysed was undoubtedly teachers in initial teacher education. However, some studies combining in-service teachers, university teachers or school students were been analysed.

Taking into account the specific objectives set out, the following should be highlighted. In relation to the main issues addressed by the research, it should be stressed that the studies promoted the need for committed and collective education to be produced from higher education [22]. Within teacher education, it is essential to develop ESD, creating learning environments that renew current educational structures [7,13,16]. It is necessary to create teachers who possess the necessary competencies to act and transform themselves critically towards ESD [34,74,75]. The development of these competencies in teacher education requires university teachers to be involved and incorporate the principles and values of sustainable development into their teaching practice [16]. In addition, teachers must have an attitude that is receptive to change, requiring an interdisciplinary approach to the curriculum, with methodologies and approaches that favour ESD [5,6,11]. A sustainable curriculum must be promoted that offers a proposal for training future teachers in sustainability competencies [5,16] using an education that is characterised by being collective, committed, inclusive and student-centred so that the student becoming an active person in the face of social transformation [26,27,30].

The main results and conclusions of the sample analysed revealed the need to develop ESD in teacher education [12,18,48], which will involve taking into account a series of factors that facilitate or hinder the process. Among the facilitators we found were working from competencies in sustainability [26,75] based on an interdisciplinary, systemic and creativity-driven approach, as well as pedagogical innovation and discovery [7,16,76]. This, in turn, was accompanied by difficulties, where the development of sustainability competencies was a slow and costly task even more so when it came to their evaluation [20]. Changes should not only be based on the acquisition of theoretical or practical content but also on the promotion of methodologies, approaches and evaluations in line with ESD principles [15].

Another of the most relevant conclusions was based on the lack of ESD teacher education [22], which is why they continually emphasised the importance of developing education in ESD [1,26]. Lifelong training, in line with the reality and the environmental and social context, allows understanding sustainable development from all its dimensions [24]. Training must accept the challenge of integrating ESD by modifying the content and teaching and learning methods [62]. Among the most mentioned characteristics, it is worth

highlighting that ESD has a student-centred approach, meaning that it is a learning process in which students actively participate based on experiences and personal development [22].

5. Conclusions

In conclusion, it should be pointed out that (a) there was a predominance of qualitative designs in the research analysed; (b) 35% of the papers were published in *Sustainability* and *International Journal of Sustainability in Higher Education*; (c) the most cited keywords were “future teachers of education”, “teacher education”, “pre-service teachers”, “pre-school teacher”, “in-service teachers” and “teacher competencies”; (d) 83% of the documents were published in Europe, with Spain being the country with the highest number of publications; (e) 57% of the research was carried out in several university contexts, either in the same country or in different countries; (f) most of the participants in the studies analysed were future educators; (g) the main themes according to the studies analysed were “engaged education”, “critical teacher capacity”, “interdisciplinary approach”, “meaningful learning”, “assessment of ESD competences”, “integrating global changes towards ESD at all educational stages”, “integration of ESD in the university system” and “holistic approach”; and (h) the results analysed from the main documents were organised around three areas of ESD: development, education and impact. In terms of ESD development, the enablers were competences based on interdisciplinarity, holistic approaches, active methodologies, evaluation of the work being developed in ESD and the need to install these changes in teacher education. Difficulties in their development were the lack of knowledge about sustainability competences, shortcomings in evaluation and a lack of holistic approaches. As for the other area, namely, education, the results analysed in the research call for the need for training to integrate ESD in the university context while distinguishing between training for students and teachers. This requires its incorporation into teacher training curricula. Finally, the impact area has highlighted some of the programmes that were or are currently being developed and their impact on ESD.

The main limitation of the current study had to do with the content analysis process, as no software was used to classify the documents. In conclusion, it is worth noting that this review provided a wealth of information on elements that proved successful in particular contexts and circumstances and that could be applied in different settings and opportunities with appropriate adaptations.

Author Contributions: Conceptualization, S.L.-E.; methodology, S.L.-E. and I.C.-L.; software, S.L.-E. and I.C.-L.; validation, S.L.-E., B.M.-P. and I.C.-L.; formal analysis, S.L.-E., B.M.-P. and I.C.-L.; investigation, S.L.-E., B.M.-P. and I.C.-L.; resources, S.L.-E.; data curation, S.L.-E., B.M.-P. and I.C.-L.; writing—original draft preparation, S.L.-E.; writing—review and editing, S.L.-E.; visualization, S.L.-E., B.M.-P. and I.C.-L.; supervision, S.L.-E., B.M.-P. and I.C.-L.; project administration, S.L.-E.; funding acquisition, S.L.-E. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by a Ph.D. fellowship from the Government of Aragón.

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Ethics Committee of Research Ethics Committee of the Autonomous Community of Aragón: CEICA (protocol code: PI21/076 and date of approval: 10 March 2021).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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