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Sustainability through STEM and STEAM Education Creating Links with the Land for the Improvement of the Rural World

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Abstract: Rural environment is suffering from serious problems, as reflected in the term "Empty Spain". One of these problems is the pronounced depopulation that rural areas suffer in our time, so creating links with the land thanks to education is of great interest for, among other things, establishing population in rural areas. Interdisciplinary education becomes relevant today as the necessary education in our current world capable of providing answers and solutions to the social demands of our time. Interdisciplinary STEM education had the United States of America as its cradle in the 1990s; later it passed to the acronym STEAM when the Arts were later introduced, this is how you find a true interdisciplinary education. Since 2010, government policies have been developed in the USA, highlighting the Educate to Innovate program and in that same country the STEM4SD Education program, which develops education for sustainability by creating links with the local population. Precisely, this article will collect the educational policies that have been carried out in the USA for the development of this type of education. In this article and thanks to the analysis of certain programs, the importance of interdisciplinary STEM and STEAM education in our days will be exposed for the promotion of sustainability directed towards sustainable development, thereby creating more sustainable societies made up of more sustainable citizens, highlighting the importance of education for sustainability through STEM and STEAM education creating links with the land for the improvement of the rural world, which means establishing population, among other aspects.

Keywords: education for sustainability; STEM; STEAM; land; rural environment; interdisciplinary education; USA; Spain

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1. Introduction

If we refer to the current concept of sustainability, we must approach it as a concept with a holistic character capable of providing a sustainable path to human development in the 21st century without future generations losing resources or factors of the planet. When we think about sustainability today we do not lose that holistic characteristic of the concept accepting the foundation of the development of the human being as a sustainable development where all its activities are related within it, considering sustainable development also as a whole, where all actions must go perfectly adjusted to achieve holistic sustainability in all areas.

But we must not forget that the concept of sustainability has undergone an evolution in our time. Each of us will come up with an idea or several ideas when thinking about the concept of sustainability. As Bermejo [1] expounds, several adjectives have been identified with sustainability over time, such as ecological, green and even blue (in relation to the image of the blue planet).

Human responsibility in achieving sustainable development must be present in each of our actions and deeds, as well as in our way of life. But before reaching the point of being responsible citizens, we go through other stages: conscious citizens, strategists and finally responsible citizens. Let us recall in this line the words of Mihalic et al. [2]: The "awareness" phase involves social awareness of all sustainability issues, stimulates sustainable ethics and informs the destination about appropriate and inappropriate behaviors. In the next phase, sustainability challenges are translated into objectives, codified in destination strategies and included in their "agendas" and lists of relevant policy instruments. The last phase is sustainability implementation or responsible "action".

According to the above, for citizens to be first aware, then strategists and finally responsible for working towards the sustainability approach, one of the aspects lies in education. The relationship between education, sustainability and environment, we find in the 2030 Agenda, where it talks about Education for Sustainable Development (ESD) [3,4]

Together with this aspect, we indicate STEM and STEAM education; we must remember the Rocard report [5] of the European Commission (Directorate-General for Research Information and Communication Unit) where the scarcity of vocations in the scientific-technological field, identified as STEM, is pointed out; this scarcity was related to the difficulties (at the level of purchasing power as well as at the gender level) of accessibility to them by the student body. It is important to enhance the knowledge variable in STEM disciplines in the educational and university system and to involve the incorporation of women in work spaces related to these areas of knowledge [6,7]. To reduce gender inequality, countries have had to develop different programs in which the government and academia have combined efforts for gender inclusion in terms of STEM competencies [8].

Bybee [9] is interested in STEM education, whose origin comes from the disciplines Science, Technology, Engineering and Mathematics, and analyzes the different ways in which this concept is used. Bybee [9] puts the focus on STEM education to improve the knowledge of science disciplines in new generations of students, as opposed to the traditional educational approach, although he points out that there is still confusion and debate about the implications of STEM education. However, despite the debate, it is clear that STEM education goes beyond traditional education, as it seeks to provide solutions to current environmental, social, and economic problems by interconnecting science disciplines. Kelley and Knowles [10] note that the loss of interest on the part of students towards science disciplines is related to the scarcity of interrelation between these disciplines as well as lack of real-world applications. As we are seeing, STEM/STEAM education involves factors beyond mere traditional education, so it is essential that, if students are to acquire competencies and skills interrelated with sustainability, the economy and, ultimately, the real world, it is the teachers who must be prepared to transmit such a mission. It is important that teachers perform self-criticism to improve STEM education capacity [11] and know how to integrate STEM education factors so that students can acquire the knowledge and skills of these disciplines in the real world [12]. For this it is necessary that teachers are properly prepared and committed to STEM education [13,14] and that, of course, teachers can develop their activity with job continuity [15] and have adequate teaching tools for their professional activity; in this sense, training programs have been developed in diversified classrooms, in urban areas [16] or in rural areas, although in a very specific way [17].

STEM education can be developed at all stages of education, from pre-school to university. Although STEAM education seems potentially rich to foster engagement and learning of more students, it presents numerous challenges, including the preparation, willingness and confidence of teachers to adopt such a curriculum, as highlighted by Kim and Bolger [18]. In fact, in relation to STEM education, and agreeing with Xu and Ouyang [19] it should be noted that we are facing a complex system, where not only science disciplines interact, but also the educational community, teachers, students and their environment, social, economic and environmental factors.

A relevant aspect in this field of action corresponds to the gender gap. Currently, women are underrepresented in the STEM field and it is important to be able to break this

trend by focusing on STEM education at an early age [20,21]. Within this education, it is worth highlighting the gender gap described in national and international [22,23] studies where we can conclude that it is boys versus girls [24–27] who present greater interest in these science disciplines from the early educational stages [28], along with socioeconomic factors and STEM teaching practices. In Germany, Goreth and Vollmer [29] point out that the low participation of women in STEM professions does not correspond to the students' own gender difference but to the "different technical socialization of women and men" so they invite to change the views of the current normative roles for women and men. It is necessary to break the stereotype of the student of STEM disciplines (male, urban, acceptable socioeconomic position) from an early age and open the world of science to the female gender.

On the other hand, within the context of rural education, several studies establish the differences in performance between urban and rural students, in relation to science [30] and mathematics [31,32]. We come across blended learning proposals to improve academic performance in rural areas [33], and school networks to improve rural schools [34]. Another important aspect to improve rural academic success corresponds to the training of rural teachers, especially school principals [35]. However, there are still gaps to be studied in rural schools, as pointed out in the review by Fargas-Malet and Bagley [36], in relation to the promotion of research at early ages, research "with the children", and not "of the children". Likewise, they indicate, as do other authors, that studies have been carried out in relation to the availability of resources, population shortage, lack of funding, which is why many rural schools tend to close. However, they propose strategies to favor these rural schools, from the training of suitable teachers, virtual learning . . . A very relevant aspect emphasizes the strong links developed between the rural school and the place, so they propose "place-based curricula". The sustainability of rural schools will also depend on the members of the educational community themselves [36].

The rural environment offers a myriad of learning opportunities, both in formal and informal education. As Goodpaster et al. [37] argue, a large part of the rural "way of life" is the management of the social aspects of rural education, both in and out of school, strengthening ties with the land. Studies with implication of education in the rural environment under STEM scenario we can observe it in the one developed by Ihrig et al. [38] where they evaluated, in economically disadvantaged communities, experiences of teachers and high-performing rural students who participated in an extracurricular STEM talent development program, where they supported the use of STEM informal educational environments.

It is in the scenario in which the present work is developed, education for sustainability, but focused on the rural environment, so the main objective of this work is to highlight, through a qualitative approach, rural STEM/STEAM education as a possible solution to the depopulation of rural "empty Spain". Like other educational movements, STEM comes from the political and educational sphere of the USA [9], although in recent years it is promoted internationally [39,40] also in the European Union [8]. The work focuses on the USA, the country in which STEM education emerged and which has developed educational policies and educational programs of interest in this type of education. Subsequently, the situation in Spain has been analyzed in terms of STEM/STEAM, looking for its applicability in rural areas, as a strategy to be taken into account when fighting against depopulation.

1.1. Evolution of International Discourse on the Concept of Sustainability

The idea of sustainability began as a preventive response to the prospect of global or partial collapse of the prevailing model of civilization [41]. Although it is true, the historical journey through the evolution of the concept is of great interest to understand the holistic concept of current sustainability. At this point, let us remember the United Nations Monetary and Financial Conference held in 1944 in Bretton Woods, New Hamshire (USA), with the assistance of 44 countries, which involved a series of agreements to focus monetary and financial development after the near end of the Second World War and there was talk of promoting peace and natural wealth, although everything that was said there

was rather aimed at Europe and its recovery after the war situation. Years later the concept of sustainable development would emerge, a concept that was is supported because such a system does not threaten or challenge in any way the neoliberal structures of privilege and reproduction of capital that the capitalist system imposed and spread through the Bretton Woods institutions [42].

In the 1950s, a visible increase in pollution began to take place, leading to an awareness of the situation that produced such pollution in the environment. These facts provided a basis for the development of environmental ideas that forged the future of what would later be known as modern environmentalism. Some ideas began to be forged in this decade that would be the basis for modern environmentalism or ecomodernism [43] that would serve as a beginning to face the future of the development of modern society.

A decade later, in the 1960s, is when we can certainly locate the origins of the aforementioned modern environmentalism, due to the environmental detriment that was already latent at that time and the appearance of a growing concern for the then-existing environmental deterioration. As Bermejo [1] states, in the 1960s there began to be awareness of the proliferation of serious environmental problems that occur especially in OECD countries. With such a situation we remember in 1968 the celebration in Rome of the so-called Club of Rome where great connoisseurs of the situation met to discuss the concern for ecology and the increase in environmental concern of the moment.

In 1972 the Stockholm Summit is held, an international conference in which dangerous levels of pollution and environmental problems are considered. We must emphasize that in this Summit the importance of education in environmental issues is mentioned. As would be collected 30 years later at the Johannesburg Summit at the Stockholm Summit they agreed on the urgent need to address the problem of environmental deterioration [44].

In the eighties, reference should be made to the fact that the United Nations published "Our Common Future", the so-called Brundtland Report, published exactly in the year 1887, a report of great interest due precisely to the issues addressed for the first time on the concept of sustainable development. It defines the concept of sustainable, lasting development, that is, ensuring that it meets the needs of the present without compromising the ability of future generations to meet their own (Brundtland Report, 1987). Precisely in the Preface of the President of the Brundtland Report explicit reference is made to responsibility, "*We live in a time in the history of nations in which coordination of political action and responsibility is needed more than ever*" [45]. Responsibility is a value that, when put into practice to achieve sustainable development, will mean that each action or activity of the human being has that connotation of help and social improvement for the future in common, including the different stages of social awareness [2].

Also in the Preface of the President of the Brundtland Report we find the demand of necessity that was made "*What is needed now is a new era of economic growth, growth that is powerful as well as socially and environmentally sustainable*" [45]. We see in these words the not only environmental focus of sustainability, but also social, something of great importance in the magnitude of the concept.

In 1992, the Rio Summit [46] takes place, in which the three components of sustainability are already observed and which was collected in the Johannesburg Summit as Nogales [47] cites "*the integration itself of the environment and development, with the three components of sustainability included: social, economic and environmental*". At this Summit, a global strategy is agreed to achieve sustainable development based on global cooperation, establishing 27 principles on the rights and responsibilities of nations in the progress and well-being of humanity [48]. If we refer to Principle 7 "*Developed countries recognize their responsibility in the international pursuit of sustainable development . . .* " and Principle 13 States should develop national legislation regarding liability and compensation for victims of pollution and other environmental damage" we summarize that the concept of responsibility of the human being is exposed as an essential value at this time for the scope of sustainable development. In Principle 10 "*States should facilitate and encourage public awareness and participation by making information available to all*" something very important appears in

all this and it is the concept of awareness: raising awareness among the population by States will be crucial to deal with all environmental issues. Principle 11 "*States shall enact effective laws on the environment*". This principle already makes us reflect on the laws that can be enacted and that are effective in protecting the environment, living beings, their habitats, the land they inhabit, etc. And here we could expand this idea and take it to the educational field, to the educational laws of each country. In Principle 22 of such a document, an explicit reference is made to local communities "*playing a fundamental role in environmental management and development due to their traditional knowledge and practices*". The local already takes on achieving sustainable development of great importance for all that it implies in terms of culture and knowledge.

In 2002, the Johannesburg Summit is held, we must highlight two documents: the Johannesburg "Declaration on Sustainable Development" and the "Action Plan". The Declaration once again reflects the importance of responsibility and of local communities "*we assume the collective responsibility to promote and strengthen, at the local, national, regional and global levels, economic development, social development and environmental protection, pillars interdependent and synergistic of sustainable development*". As noted by Nogales [47], this Summit in Johannesburg is a meeting on sustainability, in which they are going to talk about how to achieve greater development while respecting the environment, for developed countries and those that are developing.

In 2015, an important event took place when world leaders adopted goals aimed at achieving sustainable development, the so-called SDGs (inheritance of the old Millennium Development Goals, MDGs). The 17 SDGs consist of 169 goals to achieve a better planet for all by 2030. The 2030 Agenda for Sustainable Development proposes action in all areas and at all levels, from the international to the local.

The words sustainability and sustainable development have been appearing more and more repeatedly in academic-scientific studies, on the agenda of the main political parties and in all the normative proposals that have to do with public policies [41]. The concept of sustainability in our days implicitly carries a value of responsibility at all levels of action of the human being, whether on an international, national, state or local scale.

1.2. Education as a Promotion of Sustainability in Rural Areas Creating Links with the Land

The 2030 Sustainable Development Agenda with its 17 goals aims to achieve a more sustainable planet by the year 2030. All the SDGs to be met are of great relevance, highlighting among all of them SDG 4, the quality education that we will provide to young generations and children, which will be our future societies. We have currently suffered a pandemic with marked characteristics, the COVID-19 pandemic, which also led to an educational change. As Bosch et al. [49] cite, it is required that young people acquire an integrated and interdisciplinary preparation for science and particularly to understand complex problems of engineering, biology, environment, spread of diseases and epidemics, among other problems.

The need to provide quality education to the greatest possible number of people is present in all the proposed objectives [50]. SDG 4 is the protagonist as it implicitly refers to quality education in our time. If we ask ourselves what we mean by a true quality education, we must answer that it is an education capable of responding to the needs of today's society and the society of school-age generations. A quality education is an education capable of forming people who can solve current problems, people who are responsible in their acts and actions towards themselves, their environment and future generations, people capable of achieving sustainable development and capable of moving in different scenarios of holistic sustainability. With a quality education, students must be prepared for their demands and needs of the current age, adulthood and for future generations.

As Cantu-Martínez [51] cites, environmental deterioration can be observed both locally and globally. Sustainability must be understood as a whole, there are no environmental borders on the planet and the deterioration that the planet has suffered in recent decades, due to pollution and the mismanagement of its resources by human beings, is present

and observable at a local and global level and therefore we must think of local and global sustainable development. The damage produced in nature, the breakdown of biodiversity and the loss of natural resources occur at a local and global level. Therefore, since this deterioration is present at a local and global level, it can be observed from local spaces. And for all this, solutions to these facts can be found from the local level and local quality education plays a fundamental role in such achievement.

Land in rural areas is of great importance to its inhabitants. The land shows a space to live but also provides food and social welfare, it is more than the physical space where you live. The territory is not an "objectively existing" physical space, but a social construction, that is, a set of social relationships that give rise to and at the same time express an identity and a sense of purpose [52]. The territory in the rural environment offers endless opportunities and relationships to its inhabitants.

The school plays a fundamental role for the improvement of individuals and is capable of providing solutions to the problems of today's societies. The rural environment also suffers from problems of great magnitude but also offers solutions thanks to the resources that it possesses so valuable to offer quality education, fulfilling the aforementioned SDG 4 of the 2030 Agenda. In this scenario, the rural school has a role of great relevance for promote sustainability by being able to create links with the land. Attachment to the land in a sustainable way can be worked on in the rural environment by creating those social bonds with an emotional base in the rural space.

The school institution can be the space from which social capital is generated, aimed at strengthening citizenship and participation in the construction of the territory and its development [53]. Rural territorial development must be worked from a sustainable approach, observing and working on the opportunities that rural areas offer for it. The school is a necessary means for rural development that can only be sustainable or it will not be. And for all this to take place, socio-emotional-spatial links must be created between the individuals of the rural environment and the rural environment itself. As stated [53] the challenge is to be able to implement policies and actions . . . linked to school spaces, and build and expand citizenship while simultaneously contributing to the competitive insertion of the territory that allows the construction of a strategy for its development. Educational policies and actions in schools should lead us to an improvement in the quality of life in rural areas and in their rural communities, allowing rural sustainable development in all aspects and with all the meanings that the word sustainability implies, so rural development in the rural territory must be a sustainable social development, a sustainable economic development and a sustainable environmental development.

As UNESCO [50] states, sustainable development begins with education. With all this, we must see in education and the rural school a bridge to follow to create more sustainable societies capable of giving holistic responses to existing problems, including existing problems in rural areas and their territory. Education for the sustainable development, the so-called ESD, is very necessary in our time, presenting some characteristics [54]:

> "*Is concerned with the well-being of all four dimensions of sustainability: the environment, society, culture and the economy, is locally relevant and culturally appropriate, is based on local needs, perceptions and conditions but recognizes that the meeting local needs often has international impacts and consequences. It concerns formal, non-formal and informal education, accepts the constantly evolving nature of the concept of sustainability, approaches content taking into account the context, international issues and local priorities and is interdisciplinary*".

Analyzing all the above characteristics, we observe endless possibilities in education to achieve the holistic meaning of sustainability, which currently has four dimensions and not three, as we discovered at the Rio Summit, that interdisciplinary education is of great importance at the local level for meet your local demands. The actions that are carried out locally and in its territory reach national and international dimensions, let us observe the planet as a whole, without environmental borders, where the actions that take place in any land of any local community have an impact on the common planet for all.

1.3. Objetives

Our main objective of study is to consider rural education as a possible solution to rural depopulation in "empty Spain", creating links with the land between the rural population and its location in the territory. We have analyzed the problems of schools in rural areas and we have reviewed the STEM/STEAM proposals that are being developed in the USA and Spain, in order to advance in the defense of rural STEM/STEAM education as a solution to rural depopulation. The general objective is to highlight the importance of education in rural areas in order to bring about changes that will lead to the permanence of rural areas.

To achieve this objective, the specific actions developed in this study were as follows: initially, the situation in the USA was analyzed in relation to rural education and STEM and STEAM education, reviewing the educational programs and laws that have been developed in the USA, since it is the country where STEM education emerged. Subsequently, the situation of rural and STEM education in Spain has been analyzed. Finally, a diagnosis of this type of education in the Spanish rural environment has been made, trying to find, through STEM and STEAM education, a solution to the problem of depopulation in rural areas, getting young people to stay and live in rural areas, and consequently, that the villages are not as aged. Likewise, through STEM and STEAM education, a solution is sought so that rural women remain in rural areas because they have the same opportunities as men. Finally, it should be noted that carrying out an interdisciplinary STEM and STEAM education using the resources of the rural environment will create an awakening of sensitivity in the students towards their environment and the land that surrounds them, developing links between the land and the students.

To accomplish this objective, we have developed a qualitative methodology, initially identifying the concepts of interest, their relationships through scientific literature in the USA and Spain. After reviewing the articles, we conducted an analysis and synthesis of the key factors that should be taken into account to develop rural STEM education. The results are shown below.

2. Rural STEM/STEAM in USA

2.1. Rural Situation in USA

Although there is no single definition of "rural" [55], we understand rural regions as areas with less populated settlements than urban regions, where the population is fundamentally dedicated to developing an economy based on the primary sector, mainly agriculture and livestock.

According to the National Center for Education Statistics, 9.3 million children are in public rural schools. In the report by Provasnik et al. [56] the situation of rural education in the USA is shown. The new classification system of the National Center for Education Statistics (NCES), classifies twelve categories of location of school districts. As far as rural location is concerned, he distinguishes between three types of rural areas:

- rural areas that are on the periphery of an urban area.
- rural areas that are at a certain distance from the urban.
- remote rural areas.

The rural population in the United States is declining over the last decades (Figure 1) despite the fact that the rural area is greater than the urban area in the US, according to the US Census Bureau.

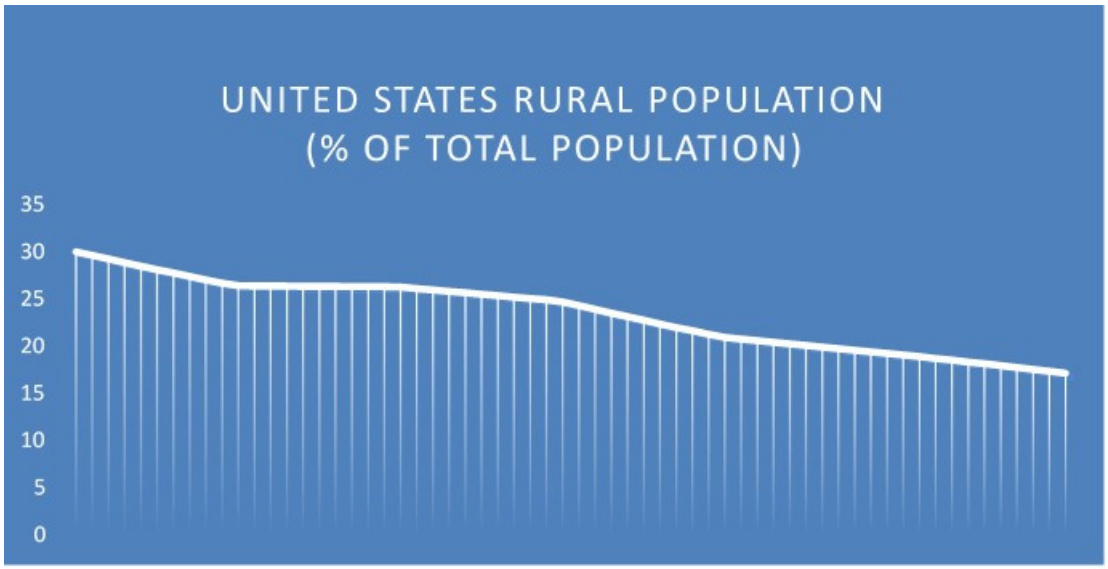

Figure 1. World Bank Rural Population Estimates (1960–2021). Rural population refers to people living in rural areas as defined by the national statistics office. It is calculated as the difference between the total population and the urban population. Source: World Bank.

In 2016, rural areas covered 97% of the land area of the country, but contained 19.3% of the population (about 60 million people). Population growth has slowed in recent years due to lower birth rates and declining net international migration, while death rates are rising due to the country's aging population.

In 2020, there were approximately 57.47 million people living in rural areas in the United States, compared to approximately 274.03 million people living in urban areas.

The decrease that the general rural population has suffered during the last decade (2010–2020) has not been carried out homogeneously throughout the country, since there are rural areas with a developing population (those with greater purchasing power) compared to rural areas in decline (those with the highest level of poverty). This change in the population does not only respond to the level of wealth, since the type of developed local economy has favored, in some cases, the increase in population. This is the case of an economy based on tourism and leisure, both for young people and retirees [57].

In relation to education in the rural environment, we must point out that rural America does not present homogeneity neither in the geographical aspect nor in the populations, since it is made up of diverse communities, where different races and cultures coexist. Rural education is under threat due to racial and class inequality [55]. Differences in graduation rates based on race (white vs. Latino and African American) remain, with rural public schools reflecting the class and racial segregation of the surrounding area.

One of the main problems to overcome this inequality is closely linked to public funding, it is essential to increase the budget dedicated to these public rural schools. Nugent et al. [58] points out the importance of being able to meet the budgetary needs of almost ten million children who attend schools in rural communities across the country, which represents about 20% of the nation's student population and more than 23% of the state. Public funds continue to be claimed to achieve competitiveness in rural schools, since there are situations where access to advanced courses is limited for students from rural areas. An example is found with Advanced Mathematics, whose offer in rural areas is half that in urban areas. To this situation, we must add the shortage of rural teachers in key areas, such as STEM subjects and English, as well as the high turnover of rural teachers due to the fact that their salary is usually lower than that of urban teachers [59]. This situation is also reflected in Canada, in the study conducted by Barter [60]. In 2006, research was initiated to evaluate this problem in rural regions and to extrapolate it to different rural localities. From the point of view of young graduate students and future teachers, problems

related to the curriculum, lack of consolidation in the position, heterogeneity in teaching assignments . . . were identified. These issues should be taken into account to improve the competitiveness of the rural school.

In order to improve the activity of the rural teacher, the study by White and Kline [61] provided a series of resources for rural teachers, adapted to the rural school, in order to help students in education at school and in the community. This proposal is in line with the suggestions of Corbett [62], who pointed out that the preparation of rural teachers should go beyond professional training to "support ways of thinking about teaching in rural contexts that are not standard and directly address problems persistent and pressing rural issues such as: population loss, resource industry restructuring, resource depletion, environmental and habitat degradation, and political land use.

Throughout this section, we can highlight the importance between school and location. Thus, when we talk about localized education, we must work with the proposals of Corbett [63], since the particularities of the school's location must be part of the school's curriculum, in such a way that it is crucial to be able to connect the community in the rural school, in order to reach the academic and educational success of the students. However, according to Corbett, it is not about nationalistic policies, but about adapting and taking advantage of the resources of the community itself.

Thus, in rural areas, the school takes on a broader meaning than in urban regions, as it implies a greater commitment to the community in which it is based, improving and increasing the services necessary for its proper functioning, and offering new opportunities [55] so that strong links are established between the classroom, the school and the rural community.

2.2. Sustainability in Educational Laws and Use of STEM/STEAM Programs Promoting Sustainability in the USA

Interdisciplinary education allows us to work as a whole on sustainable development. ESD is interdisciplinary because no discipline can appropriate ESD for itself; all disciplines can contribute to ESD [54].

STEM education, an acronym for Science, Technology, Engineering, and Mathematics began to gain strength in the US in the 1990s. The subsequent STEAM education also introduced the Arts, making it more complete. STEM/STEAM education is an education capable of solving current problems. As cited by Sanders [64], design and scientific inquiry are routinely employed concurrently in the engineering solutions to real-word problems. According to Toma and Greca [65] the meaning of STEM education is reflected in its main objectives: (a) respond to economic challenges . . . , (b) identify the needs of workers . . . to adjust to current labor and social requirements, and (c) emphasize the need to solve technological and environmental problems. A major environmental problem in our time is climate change and its work in schools is of great importance in our time. As Watson [66] exposes with climate change and other environmental concerns becoming evermore present and cumbersome, there is a necessity for increased education on these issues, especially in the United States.

In 2010 is when this concept of STEM education gains strength as it is present in the government policies of that country. As stated by Bosch et al. [49] President Obama announced the "Educate to innovate" Program convening key community leaders and a series of associations, companies, foundations, non-profit organizations and science and engineering societies [67]. In this section we must highlight the publications Improving K-12 STEM education and Improving STEM higher education [68–72]. In addition, the Administration took steps to further bring STEM education to certain groups by highlighting girls and young women Through innovative arrangements such as the NASA/Girl Scouts of the USA partnership, the Department of Energy's Women in STEM mentoring program, and Numerous other commitments agencies across the Administration and the private sector are creating opportunities for students [67,73]. In the USA, a STEM Education Plan is drawn up every five years, the plan is a mandatory component of the America COMPETES

Act of 2010, which requires that the Committee on STEM (CoSTEM) [74] and the White House Office of Science and Technology Policy (OSTP) draw up a plan every five years related to STEM education in that country.

Also launched the STEM plan, highlighting in this section Progress Report on the Implementation of the Federal STEM Education Strategic Plan (17 December 2020) [75], Charting a Course for Success: America's Strategy for STEM Education (December 2018), Summary of the White House Release Event for the 2018 STEM Education Strategic Plan (4 December 2018) [76], Summary of the 2018 White House State-Federal STEM Education Summit (28 June 2018) [77], Progress Report on the Federal Implementation of the STEM Education Plan (16 October 2019) [78].

Recently STEM education is also gaining in importance. In June 2022 the Departments of State and Homeland Security are announcing new actions to advance predictability and clarity for pathways for international STEM scholars, students, researchers, and experts to contribute to innovation and job creation efforts across America [79]. And more recently, in September 2022, it has been published Interagency Roadmap to Support Space-Related STEM Education and Workforce, a report by the National Science and Technology Council of the Office of Science and Technology Policy.

Practically all American Universities have organized STEM Institutes or Centers [49]. An institution to highlight in this section is Arizona State University, as it has the first School of Sustainability in the world. We emphasize at this point that the state of Georgia was the first to include STEM education in the Curriculum. In the 13-year pre-university basic formal education (K-12), STEM education is worked on. The Washington State K-12Integrated Environmental and Sustainability Education Learning Standards describe what all students should know and be able to do in the area of Environmental and Sustainability Education [80,81]. New Jersey became the first state to put climate change in K-12 education standards, teaching climate change topics in classrooms from kindergarten through high school.

In the USA, a STEM education is developed for sustainable development (STEM4SD), promoting an idea of STEM education in a transdisciplinary framework, acknowledging the complex context of global challenges and the need for integrating values, ethics, and world views towards the development of sustainability mindsets and using science to do social well [82]. STEM4SD Education is an education for today's world where Interdisciplinary STEM education is developed with a focus on sustainable development. One of the centers that works with STEM4SD Education is the Smithsonian Center for Science Education (SSEC) who promote STEM education for sustainable development.

According to Pahnke et al. [82] the offers of STEM Education for Sustainable Development (STEM4SD Education) must be guided by some guiding principles, let's see the following:

> "*Empower present and future generations to use science, technology, engineering, and math (STEM) skills and reflective reasoning to solve complex sustainability problems*".

This makes us reflect on the importance of a STEM education for the future that works on all the Goals of the 2030 Agenda, to achieve a fairer and healthier planet by 2030, where sustainable development is not a utopia, but rather a constant work of each one of us. STEM education is an opportunity for today's world to use all the knowledge of Science, Technology, Engineering and Mathematics for the service of the human being to make an education that creates more responsible citizens capable of responding to existing problems in the current world, always from a sustainable point of view, whatever the problem, recalling at this point the current concept of sustainability as a holistic concept that includes all the sustainabilities that can occur in our current world.

2.3. Sustainability through STEM and STEAM Education Creating Links with the Land for the Improvement of the Rural World

If we continue with what Pahnke et al. [82] expose about the offers of STEM Education for Sustainable Development (STEM4SD Education) and that some rectors should be guided, we will now remember the following:

> "*Encourage autonomous thinking and responsible action that takes place in the context of the student and involves the social and natural environment of the institution, providing the opportunity to implement and experience real changes in the community of students, even on a small scale, which then strengthens their agency capacity*".

This brings to mind what we discussed in the previous section on the concept of sustainability in our days and that it implicitly carries an action of responsibility in the human being in each of his acts and actions. By promoting responsible action through STEM4SD Education, that autonomous thought, which involves the student and the environment (understanding here the local, the rural if it is present, the land of the rural then) makes us understand that there will be real changes, that they will be present in the acts and actions of the students reflecting in their activities and their behavior with the environment. With STEM4SD Education, skills are developed so that students can make connections between the personal and their local world, and the personal and their global world.

USA has launched policies and laws to improve rural education. In 2021, the bipartisan Rural STEM Education Research Act was passed, a law that supports research to address the challenges facing rural communities. Laws like this allow to emphasize learning in the rural world with educational foundations in place, giving students the opportunity to work through a STEM education in their communities and in their rural environment.

We must also mention the program (REAP) that was created to help rural schools. We must also mention the Rural and Ready STEM initiative, which is an initiative to improve STEM education in rural areas. According to Buffington in an interview conducted for the Education Development Center in 2019, Rural and Ready STEM has three goals: to help rural teachers improve their science teaching and learning, to help rural districts support and maintain high-quality science learning and use technology to support STEM practice.

Many articles suggest that parents' views of STEM education in rural areas are inconsistent with the realistic need for students to learn principles and skills from the field in order to compete in today's economy [83]. From this point of view, one wonders if it is not important that students develop attachment to place through STEM education for the development of place (local/global) in a sustainable way. It is important to learn the principles, the skills to work the land, but let's not forget how important it is to create links with that land if we hope that future generations want to stay on it or want to return to the land they grew up on to work it. As Williams and Nierengarten [83] maintain, this issue needs to be addressed because not only does parental attitude influence student interest and achievement in STEM, but, in rural areas, parents often play an important role in school councils and school curriculum development.

STEM education in rural areas is extremely important for rural communities, their territory and students. It is important that rural areas "*allow students to find meaning and challenging work in the communities they love*" [84]. The rural environment has something that the urban environment does not and endless resources for a quality education to work on sustainability and to create relationship links between students and their environments, between the student and the local, between the student (who will one day be an adult and will be part of a sustainable society) and the land that surrounds him.

Let us highlight at this point the interview conducted with Pam Buffington, Shona Vitelli and Jill Neumayer DePiper of Education Development Center EDC [85], who live and work in rural communities, and who believe that these areas have many assets when it comes to learning and STEM teaching. When asked if there are advantages to teaching STEM in rural areas, DePiper answered that "*Certainly. There is an amazing amount of opportunity here for place-based education*". As Vitelli puts it, "*The advantage of teaching science in a rural area is that you can use the natural environment as a teaching tool*". Buffington

comments that "*All students have a right to a high-quality STEM education, and we want to harness the natural and human resources available to us in these rural communities to make that happen*". From what we can see from her words, the rural, the local, the land has endless resources for quality STEM education. As DePiper quotes "*Rural children have a connection, a passion for the place where they grow up*". This comment from DePiper leads us to think about what that connection can be translated into, what it can lead to as an adult for that rural child. As DePiper continues, "*Rural kids may become the best advocates we have to protect our coastlines, our forests, our mountains, because they'll think, "That's where I grew up'"* STEM education, and even better STEAM, an opportunity to create links between students and their environment, the land in which they live with its living beings and their habitats, links that can be produced at an early age and that will translate into a series of actions and acts also in adulthood.

3. Rural STEM/STEAM in Spain

3.1. Rural Situation in Spain

Data from the Ministry of Agriculture, Fisheries and Food (MAPA) [86] show that the rural population in Spain continues to decline in recent decades; According to the 2020 Census, there are 7,538,929 inhabitants, which represents 15.9% of the total population in rural areas, occupying an area of the country with 84% of the total. Within the rural population, a notable difference has been detected in relation to the proportions between men and women within the rural environment compared to the urban environment: in this rural environment, compared to the urban environment, there are 9.2% more men than women. In the case of young people, the Ministry highlights a lower percentage (35.2%) than the urban one, with the worrying figure of the decrease in said rate since 2011 (9.1%), which provides a clear image of the population aged in rural areas.

These data give us an idea of the small population that lives in rural areas, so the term used of "Empty Spain" [87] fits perfectly with the small population located in large rural areas. As in the USA, the typology of rural areas is classified according to the proximity or distance from the urban nucleus, since it is related to the distribution of the population. We find areas to be revitalized (remote), intermediate or peri-urban, according to RD 752/2010 [88].

Almonte and García [89] point out "*a prolonged loss and aging of the population that puts its environmental, demographic and social sustainability at risk*" in the Iberian Peninsula. We are facing an aging and masculinized rural population, so we must focus on finding solutions that increase the female and youth population in rural areas, as Gallego [90] highlights. This fact means that we must ensure the survival of the rural environment by rejuvenating the population, providing basic and necessary services, including a rural school linked to the territory. Some recent studies have been identified where different educational stages and STEM are analyzed [91,92] exclusively STEM/STEAM programs focused on the gender gap have been developed in recent years [93–96].

3.2. Education in Rural Areas and STEM/STEAM Education

At this point we must point out that the new Education Law, Organic Law 3/2020, of 29 December, (by which Organic Law 2/2006 is modified), integrates, among other issues, education in sustainability, and the Sustainable Development Goals of the 2030 Agenda, very relevant aspects in rural STEM/STEAM education.

If we analyze how education has evolved in rural areas, we find, as indicated in the Spain 2020 Report [97], very few data and few studies on rural schools to be able to draw a priori conclusions on the characteristics at the national level. The disparity of the rural environment implies that we are facing a heterogeneous rural school, with low population density and early school dropout [98]. A relevant issue to deal with is early dropout in rural school. At the level of VET, Salvá-Mut et al. [99] detects discrepancies between territories at the national level, obtaining better results in areas of northern Spain compared to some

regions of the Mediterranean and the south with lower results, with greater abandonment of the school, however, it is not specified in rural or urban area.

Domínguez and Sánchez [100] analyze the PISA 2015 report on Spain, from the point of view of rural versus urban education. It is evident that the population, outside the cities, has been drastically reducing, and along with it, public services in the rural community, including education, have been reduced. Over the last few decades, rural schools have been closed, affecting the correct educational development of students located in rural areas. This fact is not exclusive to Spain, since, in Europe, the situation of rural society is also affected by depopulation and reduction of goods and services, presenting lower academic performance than that obtained by students from urban centers. This academic performance, an essential factor in characterizing the quality of education, is determined not only by the social and purchasing power of the student's family, but also by geographical location: it is in this scenario that the rural school should play an important role creating a link between students and the land. It should be remembered that, according to the PISA Report [101], not all communities present the same results, this demonstrates the heterogeneity of education in Spain, depending on the location of the school. The first positions are occupied by Navarra, Castilla y León, Madrid and La Rioja, compared to the communities that occupy the last positions, such as Andalusia, Extremadura and the Canary Islands.

As has been indicated, by the end of the 20th century many schools located in rural areas had already closed due to emigration to the cities. In addition, the teaching staff was reduced, they became itinerant, so that job and educational stability was seriously threatened. It should be added that the rural population is dispersed, as well as the concentration of schoolchildren is reduced, therefore, the design of the classroom in a rural school is quite different from that of an urban classroom, since, in the first case, the same teacher and the same classroom accommodated students of different ages, known as "multigrade classrooms", as indicated by Olivares et al. [102], and abilities, which increased the difficulty for students to acquire the skills required for their age correspondent, Santero-Sánchez and Macías [103] point out that this drastic reduction in the number of teachers has an impact on the lack of specialization in the teaching of subjects as opposed to the urban teacher, who does not have such a large and diverse teaching load and can devote himself to teaching the subjects of his specialty. In the case of mathematics, Santamaria [104] points out differences in the student body in this competence due to the location of the center, that is, the rural school versus the urban school. In this work, Santamaria [104] analyzes the rural issue in the PISA 2015 report. He raises positive questions that may be essential in rural centers to increase the assessment of subjects such as mathematics or science, and integrates proposals for the future National Plan for Rural School, however, currently we only find some regional initiative focused on diagnosing the situation of rural education, as is the case of Aragon, Report of the School Council of Aragon [105], or to diagnose specific cases such as multigrade classrooms in rural environment. This is the case of González et al. [106] in Andalusia; where they analyze one of the characteristic aspects of rural education: multigrade classrooms, identifying management difficulties of this type of classroom by teachers, are relevant issues that must be taken into account, in order to achieve a competitive rural education through these multigrade classrooms: "*training initial and continuous teaching, the provision of material resources and infrastructures and a greater assignment of teachers*" according to González et al. [106].

Martínez and Bustos [107] refered to the general problem of the rural school under the "invisibility" scenario, a concept that accommodates the multitude of factors that affect the loss of education in rural regions, those that range from educational policies to the administrations unaware of the casuistry of the rural world, including the lack of coordination and management between the responsible entities, as well as the lack of digitization, school dropout. Faced with this fact, Olivares et al. [102] propose the rural school in the 21st century "*open to the digital territory from the local territory*".

However, despite the difficulties presented by the rural school, it is clear that, in the 21st century, this form of education, developed in regions with low population density, is capable of adapting to new technologies, albeit very slowly. This is indicated by Pérez and Martínez [17] in Asturias. The new rural classrooms must be able to adapt to new technologies without losing the essence of local education. With the new tools we will be able to increase the link between the land and rural students, favoring "new learning scenarios" [108]. Thus, the rural classroom is presented with great potential as a source of wealth in innovation, motivation and adaptation of new methodologies, thanks to the integration between the students, the school, the community and the land. This strong bond favors the ability to develop STEM/STEAM projects.

Tamargo et al. [109] in the Autonomous Community of the Principality of Asturias, analyze the interest of Secondary school students in STEM/STEAM subjects, at an urban and rural level. We are interested in this study since a gender difference is detected, although with certain considerations: among the students who choose technical sciences, it is the boys who outperform the girls by 60% in this branch; while in the case of Health, Natural and Arts Sciences, it is the female students who outperform males by more than 50%, both in urban and rural settings. The gender difference between STEAM subjects does not show large differences in rural and non-rural environments, except in Arts and Mathematics. The study of Arts stands out, where in rural areas female students are more interested than male students, while in urban areas the opposite is true. Continuing with Mathematics and Exact Sciences, we find an inverted scenario: it is the female students in urban areas who show a greater interest (although less than that of the male students) than the female students in rural areas, who show little interest in this subject. On the other hand, an interesting issue identified in the article is the weakness related to the educational system: they detect the "*inexistence of educational policies specifically related to the integral STEAM model*".

Spain still needs to continue deepening research and integration of the STEM/STEAM model, especially in rural areas, as it lacks sufficient research to date. We corroborate this with recent bibliometric studies [110–112] where there is hardly any Spanish representation, although none of the articles identified correspond to rural areas. Ferrada et al. [110] analyzes publications between 2010 and 2018, identifying a single article from Spain on STEM in SCOPUS, although without referencing rural areas. On the other hand, in the bibliometric analysis of Sánchez and Martínez [111] conducted between 2010 and 2020 on STEM education, identifies the United States as the largest producer of published articles (33), compared to Spain (4). However, none of the publications referred to STEAM disciplines in rural areas. The results show that STEM studies have continued uninterrupted until today, although the interest generated in the scientific community has been irregular.

An important aspect to evaluate is the role that this type of education plays in the future of students. Analyzing the demand for graduates with STEM/STEAM training, it has become evident that this type of education generates professionals who are currently in demand. In a European scenario, it should be noted that an increase in the demand for professionals trained in the STEM/STEAM education system has been estimated, focused on the Vocational Training level, trying to find an outlet for occupations related to STEM sectors, among them, the IT sector. It is estimated a higher demand, with greater skills and abilities provided by the STEM study, such as creativity, cooperation, problem solving ... able to innovate thanks to multidisciplinary teamwork, CEDEFOP [113] indicates that "*around 48% of STEM-related occupations require middle-level (upper secondary) qualifications, many of which are acquired through initial Vocational Education and Training (VET) at the upper secondary level*", however, according to CEDEFOP (2015), Spain has a level of STEAM graduates below the European average [114].

According to this report, within Europe there is no homogeneity in relation to VET graduates in STEM subjects. It is worth noting that Bulgaria, Estonia and Cyprus account for more than 40% compared to Belgium, Denmark and the Netherlands for less than 20%. Spain also does not reach the European average during the years 2006, 2001 and 2015

(Figures 2 and 3). Outside of Europe, the United States, along with Canada and Australia, do have a higher percentage of STEM graduates. At the national levelMoso-Diez, et al. [115] analyzed the differences between autonomous communities, in relation to VT and STEM subjects, evidencing the interrelation between VT specialization and supply and demand.

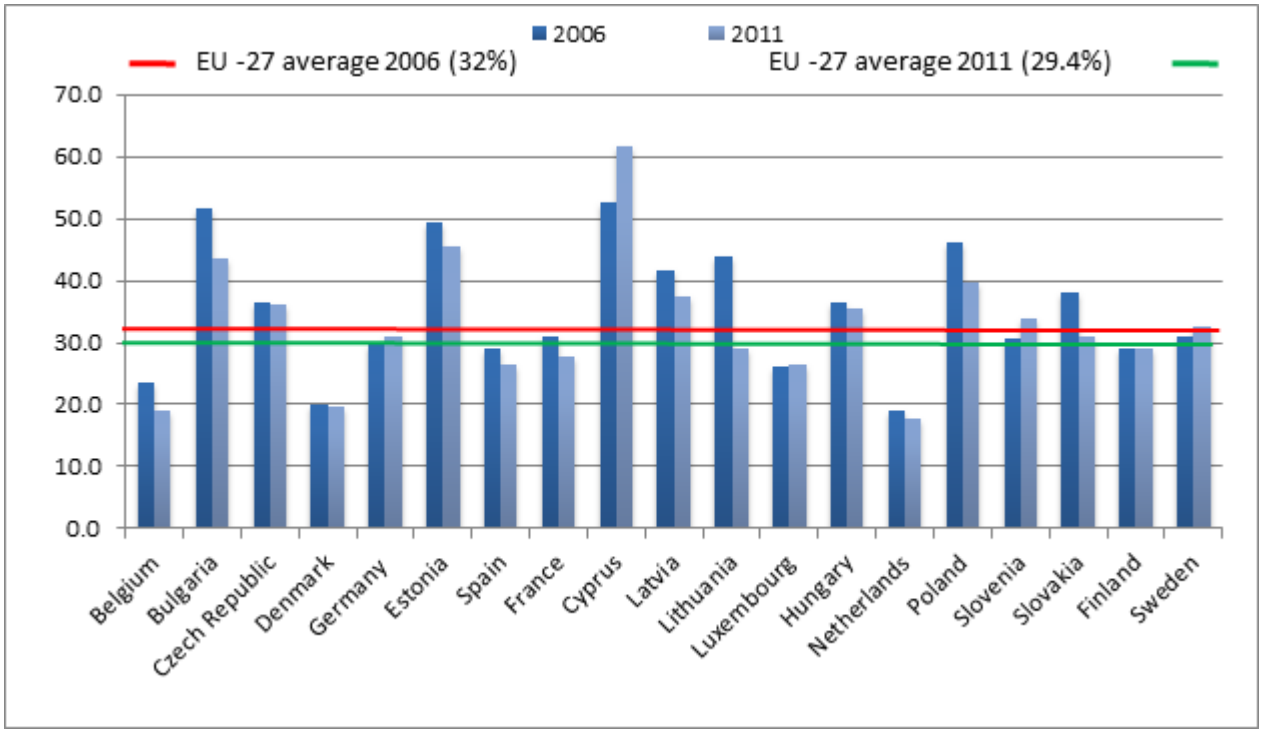

Figure 2. Percentage of VET graduates in STEM subjects in 2006 and 2011. Source: CEDEFOP 2014.

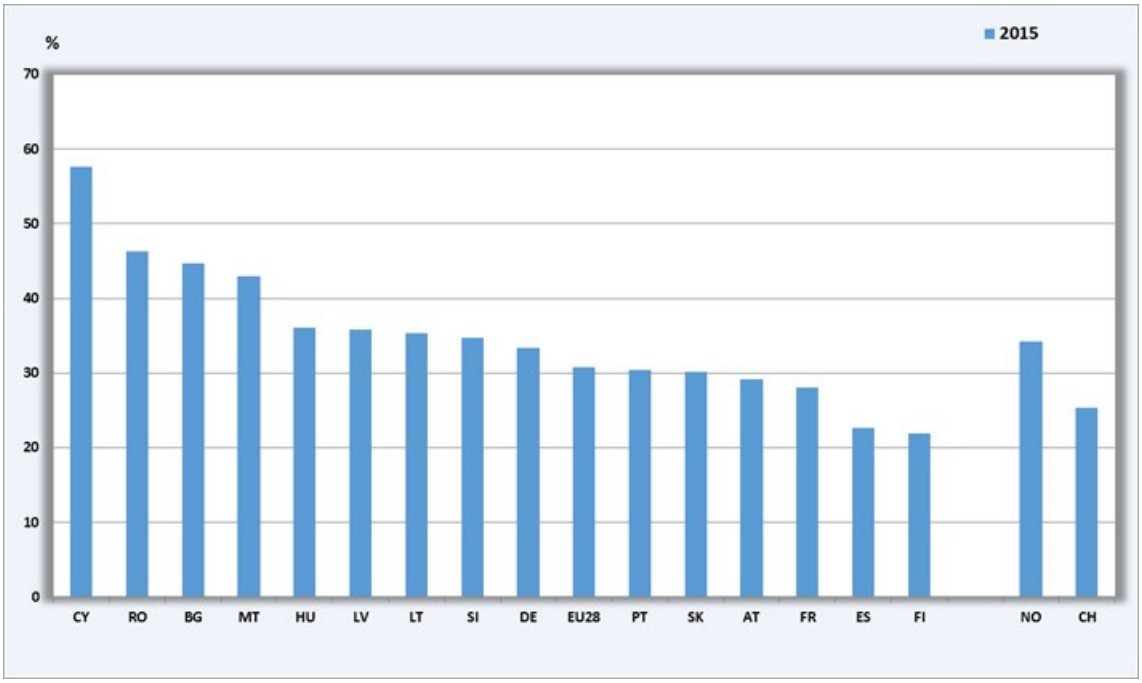

Figure 3. Percentage of VET STEM (science, technology, engineering and mathematics) graduates in 2015. Source: CEDEFOP 2015. Source: CEDEFOP calculations based on Eurostat data/UOE data collection on education.

In these graphs we can see that in 2015, although the European average has risen slightly (30.8%), Cyprus has the highest percentage (57.6%) while Spain remains below 25%, without reaching the European average of VET graduates in STEM subjects (Indicator 2050: STEM graduates from Upper Secondary VET).

According to this report, the supply of ICT and STEM graduates from upper secondary education is insufficient to meet the demand. Very few young people are studying STEM subjects. Entry requirements and dropout rates are high and women's participation is low. It is clear that, as the title of Usart et al. [27]: "*The field of STEM does not attract female talent*".

Sancha [116] proposes competencies in STEM disciplines in Vocational Education, betting on a green and digitized education. More people, especially women, are now being encouraged to study ICT and STEM subjects. In Spain, trying to promote these STEM careers among women, several studies have been published where they analyze this situation [26,117] to give visibility to women and overcome educational barriers.

One of the example can be found in the scarce participation of women in scientific dissemination channels, as is the case of YOUTUBE [118]. Tomassini [119] analyzes the gender gap in scientific-technological disciplines, identifying some gaps in STEM training; coincides with the differences detected in López Capdevilla [120], which proposes incorporating a greater number of female scientific references in the syllabus of ESO subjects to achieve a greater impact on students and a greater familiarity of women and science, not only use it occasionally. In addition, Moso-Diez et al. [121] points out that the "loss" of women and girls in STEM disciplines is detected from the beginning of the choice of related subjects, even those who choose this path have greater difficulties in leading STEM careers. This gender gap is detectable in STEM VET.

An integrated STEM proposal is proposed by Thibaut et al. [122] to increase motivation for STEM subjects and careers, however, there is no consensus in the development of instructions for this approach, so it is necessary to continue investigating to stimulate students in these subjects, providing new tools and methodologies as pedagogical alternatives, in an integral way for students [123].

Within the university world, the promising results of Martín-Sánchez et al. [124] at the University of Extremadura, to train future teachers, point to a strategy where they establish the connection between ESD and STEM through a Service Learning (SL) methodology, providing more tools to future STEM teachers. Martínez-Campillo et al. [125] confirmed the effectiveness of this methodology with undergraduate students of Business Administration at the University of León, providing comprehensive training and higher academic performance.

4. Discussion and Conclusions

One of the biggest problems in rural Spain is depopulation. In addition, the existing population in rural Spain is very old, male-dominated and with hardly any generational replacement. The rural environment is an area in demographic decline. This depopulation is a consequence of some facts, it is not a cause and as such we must face it for the improvement of the situation. We must emphasize that people have the right to be able to remain in rural areas with stability in their lives, be it economic, social, emotional and, of course, environmental. If we want to bring about change, we have to create the conditions for development in rural areas, a development that must be sustainable or it will not be. There are four fundamental factors to fix the population in rural areas: education, health, technology and employment. Education is the protagonist and the other three factors revolve around it; let us remember then the 17 SDGs of the 2030 Agenda that revolve around SDG 4. If we want changes for today and tomorrow, we must think about the education we give to our current generations of children and young people. For the rural environment to continue to be well educated, it will be necessary for rural people to have sustainable actions and deeds that speak of sustainability in its four dimensions.

Education in the rural environment presents a scarcity of research articles, not only in Spain, but also at the international level. There are common issues such as the scarcity

of resources, which cause a loss in the effectiveness of education, either due to the lack of interest of the students, or due to deficiencies of the teachers, gender, socioeconomic or political issues. Both in the USA and in Spain, problems are detected in the academic success of students in rural areas compared to urban areas, such as lack of infrastructure, low population density, lack of funding, lack of management in the administrations . . .

On the other hand, STEM and STEAM research has not been homogeneous over time; currently, in Spain it has focused on the visibility of women in scientific fields, integrating gender differences. It is important that teachers become involved in the new strategies proposed in STEM/STEAM education to reach the largest number of students from an early age. Within the STEAM disciplines, we have identified mathematics as a subject with difficulties in rural areas. The Mathematics White Paper [126] presents the STEAM approach as a source of empowerment of educational competences related to mathematics, proposing 64 measures to promote science in Spain, from different areas, including gender equality, dissemination and research. Most of the research has been carried out in urban areas and rural education is invisible to STEAM programs. It is proposed to correct this situation, as the intrinsic characteristics of rural education favor the successful development of STEAM programs in gender equality. It is necessary to provide funding, resources and a stable staff of motivated teachers to promote STEAM careers in rural areas. Conducting interdisciplinary STEM and STEAM education using the resources of the rural environment, using their land, among other things, will create an awakening of sensitivity in students to the land around them that will have short and long term consequences for the care of the land itself in rural areas.

As we have discussed, internationally, there is little research related to STEM education in rural areas. Rural education suffers from lack of resources, lack of teachers and low school performance. In the USA, STEAM and STEM programs are being developed in a more advanced way than in Spain, both in urban and rural areas. The point is that we are facing a possible solution to the Spanish rural depopulation, making use of STEM/STEAM disciplines from an early age, to foster the link between the land, its resources and the educational community as an essential part of the new generations of rural professionals. We found few success stories in rural schools, as an example we point out the work in Victoria, Australia [127] under the broad integrative concept of STEM education described by Bybee [9]. According to Murphy [127], the success of STEM disciplines in these rural schools was located in the strong link of the school with the land, with the community, with its local resources and with a motivated and committed educational community, as well as the promotion of these disciplines in the real world.

In relation to the gender gap evident in STEM/STEAM disciplines at the international level, it has been confirmed that, in Spain, the presence of women in scientific-technological disciplines is still scarce. This situation is not exclusive to Spain, as it is a global problem, as described in the European W-STEM project [128] where strategies are sought to improve the incorporation of women in science. Likewise, the 2018 UNESCO report [129] identifies obstacles in female STEM careers, where only 30% of the positions linked to STEM disciplines correspond to women. It is paramount to be able to generate interest in science from an early age, to facilitate access and motivation in scientific-technological careers. It should be pointed out that, as Echazarreta et al. [130] the economic inclusion of women in the professional world continues to be a barrier for this gender, so that we find an inequality at the international level in terms of economy and professional women, so that, if we focus on the rural scenario that concerns us, we start from the same situation of imbalance. In Spain, the Ministry of Education and Vocational Training has recently created the figure of the STEAM Alliance, from whose portal the contribution of girls and women in STEAM disciplines is encouraged from a very early age, coinciding with the work developed in Cáceres by Sandoval et al. [131] which is committed to the training of women scientists from the time they start school.

Joining the concepts of rural Spain, STEM/STEAM and women, it is important to highlight the efforts to advance in the field of women and rural STEM/STEAM, despite

the little research developed to date. We highlight the program "*Conéctateen el medio rural. Digital skills in rural Spain. Breaking the gap*", proposed in April 2022 by the "*Association of families and women in rural areas*" (AFAMMER), whose objectives are mainly focused on girls and women, seeking to stimulate their curiosity and skills in STEM careers, ensuring their entry into the digital economy. A recent example is that of the Canary Islands, where the rural STEAM Lab (https://laboratoriosteamrural.com/ accessed on 15 September 2022) has been presented, a project in which 24 rural schools have been trained in learning techniques focused on STEAM topics, and which has generated great acceptance by teachers and students. We also highlight the work of the bMaker project (https://bmaker.es/ accessed on 16 September 2022), with STEAM methodology, to increase STEAM vocations in rural areas.

Finally, it should be noted that in Spain, several authors are calling for a National Rural School Plan that integrates the new methodologies, since there is still a lack of greater involvement on the part of the institutions to enhance the value of the educational system based on STEM/STEAM strategies; localized educational plans could be planned, depending on the locality where the rural school is located, incorporating all the necessary disciplines in each of the educational stages.

We should look to US government programs and policies, specifically STEM4SD Education, to train children from an early age towards environmental sensitivity and sustainable development. The rural classroom has great potential to promote the ability to develop STEM/STEAM projects linked to the territory, and with gender equality, from the beginning of the students' educational stage, fixing population in "empty Spain". The rural environment and its territory need to move towards a social transformation born from the development of eco-sustainable competence in the local rural school. The rural environment, its inhabitants and its territory need solutions that allow a sustainable local and rural development and the interdisciplinary STEM/STEAM education for sustainability achieves such purposes.

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