

Article

# Teaching for a Better World. Sustainability and Sustainable Development Goals in the Construction of a Change-Maker University

Francisco Zamora-Polo <sup>1,\*</sup>  and Jesús Sánchez-Martín <sup>2</sup> 

<sup>1</sup> Departamento de Ingeniería del Diseño, Escuela Politécnica Superior, Universidad de Sevilla, C/Virgen de África, 7, 41011 Sevilla, Spain

<sup>2</sup> Departamento de Didáctica de las Ciencias Experimentales y Matemáticas, Facultad de Educación, Universidad de Extremadura, Avda. de Elvas s/n, 06006 Badajoz, Spain

\* Correspondence: fzpolo@us.es

Received: 4 July 2019; Accepted: 2 August 2019; Published: 5 August 2019



**Abstract:** Sustainability, as a key concept in the education field, has submitted a relevant change during the last years. Thus, there is a growing debate about its meaning. It has undergone a crucial merging of significances from many fields: Ecology, environmental awareness, but also from politics, ethics or even spiritual approaches. All these fields have been co-involved in the building of such subject concept. In this sense, this article addresses the different ways of understanding sustainability as a polyhedral concept and how sustainability can be understood under the umbrella of the Sustainable Development Goals (SDGs). Furthermore, it is proposed a conceptual framework to teach this UN Program at Higher Education, contributing to the training of undergraduate and postgraduate students from both a professional and a personal point of view. This framework is applied in a case study—in particular, in a course of Primary Teacher Degree called Didactics of Matter and Energy. This article finishes with practical consideration to build a change-maker University.

**Keywords:** SDG; higher education; competences; sustainability education; technology education; science education

## 1. Introduction: Sustainability, SDGs and the New Paradigm of Integral Ecology

Sustainable Development Goals (SDGs) arose in 2015 inside the United Nations Assembly [1] and were rapidly included in the particular countries' agenda. For example, in Spain, they were subsumed in the so-called *España Horizonte 2030 Project* [2]. They are a bunch of 17 specific challenges that UN identified as a reliable and step-by-step way in order to reduce poverty and increase global wellness. SDGs are based on five pillars: People, prosperity, peace, partnership and planet [1]. Thus, the care of the planet acquires fundamental importance for the achievement of the SDGs. The agenda puts concepts, such as ecology or sustainability at the center of the debate, including topics, such as circular production, zero waste or green and sustainable economy in the vision of human development. It seems human beings' future is absolutely and univocally linked to our planet's future, and all citizens of the planet must be involved in this purpose [3]. The relevance of integral ecology, which includes not only environmental aspects, but also sociological, economic, or ethical ones, may drive to the paradigm of Sustainable Human Development (SHD) [4].

The concept of development has changed throughout history. In the past, it was focused on economic development. At the end of the last century, Sen formulated the concept of Human Development (HD) as a process of expanding the freedoms and capabilities that people enjoy [5]. The need to unite this concept with sustainability was soon discovered, giving rise to the concept of Sustainable Human Development (SHD). SHD is defined as: “[T]he expansion of the substantive

freedoms of people today while making reasonable efforts to avoid seriously compromising those of future generations” [6] (p.18).

SHD is, therefore, the basis of a wider development paradigm and clearly enlarges the landscape of several concepts that traditionally were thought as individual fights: Human development and cooperation, ecology, ethics or global citizenship, just for mention some of them, were key ideas of many organizations (mainly related to the so-called Third Sector). In this context, the SDGs manage to put all of them in a relationship, and it makes them inter-dependent. In other words, a better world for all will be given to us only if we care about these aspects harmonically, understanding them as different faces of the same polyhedral body. In this sense, in order to achieve the SDGs, the coordinated work of all the actors must be sought: Companies, governmental institutions, non-governmental organizations, etc. [1,3].

Then the challenge is clearly to build up structures that support this new construct, that is, sustainability and integral ecology understood as the way of harmonically enhancing the living conditions of human beings.

Which is the role of universities in such a paradigm? Higher Education Institutions are evidently involved in every relevant change or turning point, mainly once the UN has indicated this one as a global-affecting. Some authors have already reflected on this [7–14]. However, we can affirm with Walter et al. that the inclusion of SDGs in universities is in its infancy [12]. The aim of this work is to deepen the contribution of Higher Education institutions to the promotion of sustainability in the context of SDGs. Firstly, the need to include this theme in the university mission will be reflected upon, and then a framework will be proposed for its implementation in the university context.

The structure of the article is as follows; in Section 2, the methodology is described. In Section 3, the importance of approaching the concept of sustainability at university is presented. Then, the concept of sustainability in the context of the SDGs as a result of the mixture of diverse knowledge is presented. Subsequently, a conceptual framework to teach the SDGs at university is presented. This framework is applied to a case study presented in Section 6. Finally, conclusions are exposed in Section 7.

## 2. Methodology

The current piece of research uses hermeneutics as a methodology. The origins of hermeneutics are associated with the interpretation of sacred texts [15], but its use was extended to other disciplines of knowledge, such as philosophy or pedagogy [16]. This methodology aims to analyze and understand reality by reading and analyzing previously written text [17]. In this way, the aim is to reach a deep knowledge that, avoiding prejudices, allows a new and complementary analysis of reality. A classical author, such as Heidegger already pointed out that there is a reciprocal relationship between text and context, which is known as a hermeneutic circle [16]. For this, the first part of the current work tries to translate concepts and facts from different knowledge areas (ecology, politics, ethics . . . ) to a common language that crystalizes in a specific vision of sustainability. This should be the academic corpus that can be transferred to University teaching through a framework, also proposed in this paper.

A framework is a tool to show structured and organized information; the situation to be modeled can be better studied and implemented in the future [18–20].

Throughout the article, several graphic representations are made to clarify the concepts exposed in it [18,20]. These representations are intended to facilitate the understanding of the concepts presented in it.

## 3. Teaching and Learning at University—More than Lessons

As Walzer stated out [21], teaching and learning at University could constitute a first-level goal of the Higher Education. In this sense, the process is much more than knowledge transfer, but an active *knowledge distillation*, moreover in the globalization times we are living in. Far from keeping the exact structures where one has been grown up; University teaching activity must also

be focused on University different ways of living for living better. That is critical thinking inside the knowledge generation.

University has not only the responsibility of making students know, but also must construct new knowledge that could be of utility in order to face the current challenges human beings must deal with. Environmental knowledge, built up including social implications, should be one of them. As Gadotti already wrote down [22] (p. 28):

In order to change the dominant educational paradigm, we need to recognize the knowledge crisis caused by the positivist model that reduces the environment to an object of study. Education for sustainable development must continue working with environmental education, which brought a new view of human relationships with the world environment—, which is no longer conceived as an object, but as a living creature that shares the same destiny with human beings. Environmental knowledge is ethical and political. It isn't only a matter of understanding ecological principles, but also involves a new concept of reality.

The role of teaching inside the university and, in a broader concept, Higher Education, should not be out of these imperatives. Actually, the environmental challenge (the sustainability challenge) goes much further than ecology (understood as environmental conservation), but involves the way to make feasible the life in the Earth, for the large majority of humans in the best possible conditions. That implies the usage of new methods and programmes, such as the current *SDG* Agenda.

In this sense, we have the intuition that a new paradigm is being born. It is not new the fact that scientific knowledge does not emerge as disconnected facts, but in a more or less harmonically assembled construct called paradigms [23], produced in *a highly organized social process* [24]. The inclusion of social, ethical, economic, and even culture spheres inside the sustainability concept is clearly a new vision of the traditional environmental awareness that probably will drive to a new paradigm, involving not only scientific knowledge, but also social aspects.

It is not a surprising thing to consider under a broader prism the ecological subject. In addition, this is in agreement with the philosophical currents of the middle XX Century. Authors as Herbert Marcuse [25] alerted about the lack of perspective in modern societies (focusing on industrialization and capitalism as oppressive structures). In a more sociological way, Zygmunt Bauman also detected a wave of shallowness that leaves not enough space to detect the deep connections inside reality [26].

According to this enlargement of the sustainability concept, university and higher education could clearly be an active stakeholder of this new construction, merging and enriching the initial environmental aspects to broader visions of sustainability. In this sense, Walzer [21] probably would have included this task inside the general university objective of being experts (and to create expertise) in the development of subjects that affect society.

The relationship between sustainability, personal development and implications, is not a new idea, e.g., Seghezzeo [27] (p. 550) already stated out the following:

In recent decades, the environmental movement has contributed to the development of personal and social identity. Environmental issues entered the international agenda and began to shape personal attitudes and governmental policies ( . . . ) This shift involves actions but also feeling ( . . . ) Therefore, we should not only care about material 'outputs' but also about the 'inner life of being that produces those outputs'.

Sustainability has to do, hence, with persons, with ways of life and thereafter with moral and ethical issues. The relationship with this new transversal paradigm (beyond environmental implications) must be included in the general tasks the university has to develop. Why? This has to do with the concept of the university itself, and if we retrieve inspiring words from the Spanish philosopher from the beginning of XX Century Ortega y Gasset [28] (p. 20):

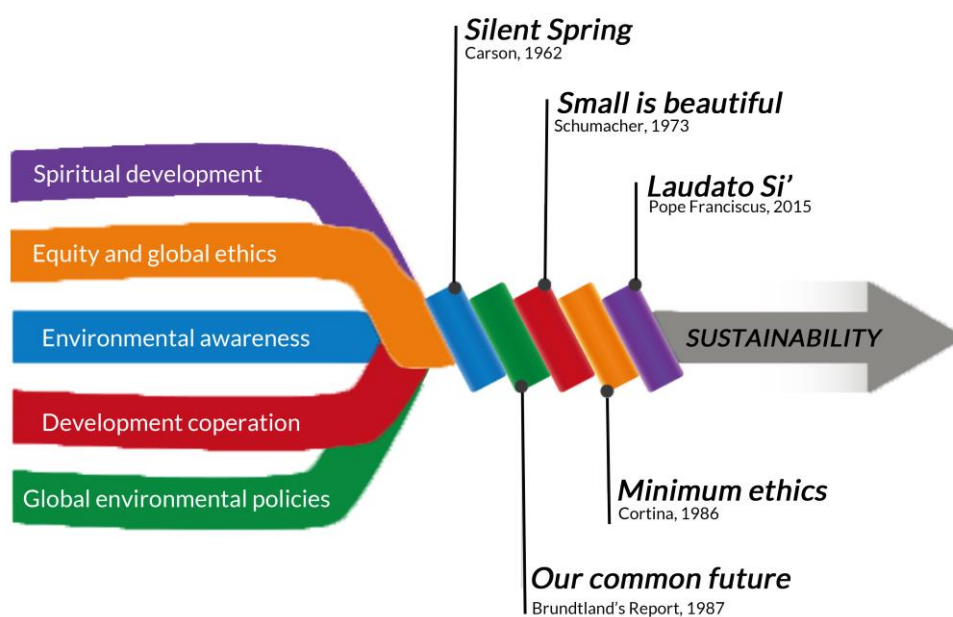
It is a question of life and death for Europe to put this ridiculous situation to rights. And if this is to be done, the university must intervene, as the university, in current affairs, treating

the great themes of the day from its own point of view: [C]ultural, professional and scientific. Thus it will not be an institution exclusively for students, a retreat *ad usum Delphini*. In the thick of life's urgencies and its passions, the university must assert as a spiritual higher power ( . . . ). Then the university will become again what it was in its best time: [A] promoting principle of History.

Ethics and moral development are present—however, in current visions of the university [29]. For example, we agree with Boni et al. [7] when they stated out that “a good university would in turn problematize the growing inequality gap in society and discuss better ways of fostering a decent society” (p. 24). This is said from a particular point of view, that is, the problem of human development. However, if we go through general considerations, Cortina already assessed the role of the university in the specific building of a better society, whatever the stage of development it is [30]. The relationship between SDG and ethics has been previously addressed [13,31]. In this context, universities can be builders and catalysts required for SDGs achievement [4,7,12,32].

#### 4. Sustainability as Integral Ecology, or the New Paradigm of Humans-Earth Relationship

Figure 1 presents a proposal for the multi-integration of several dimensions into the key concept of sustainability. There is a way from, at least five apparently different dimensions (spiritual development, equity and global ethics, environmental awareness, development cooperation and global environmental policies) and the sustainability key concept. Let us see how they were merging one into the others and how they construct itself was built up.



**Figure 1.** Construction of sustainability construct.

First of all, the origins of sustainability, as we knew it, must be placed in environmental awareness. This idea was, in the beginning, a transversal line that usually was presented as “caring the nature” while people slowly realizing of the limited availability of resources and the damage pollution and uncontrolled disposal caused to the environment and human beings. However, Carson’s “Silent Spring” [33] pointed out environmental awareness as a global concern, with global implications and global need for measures. This is perhaps the first time in history; global warming is detected and focused on. This author begins a way of talking of ecology from a different point of view, afterwards called “deep ecology”.

In this sense, Brundtland Report “Our Common Future” was the first response with worldwide scale, making these two initial dimensions (Global environmental policies and Environmental

awareness) to merge one into the other [34]. It was the seed for other Programmes, such as Millennium Development Goals [35] or Sustainable Development Goals [1].

Development cooperation was the following dimensional line. Traditionally, the concerns about the development question (why some countries are less developed than others, how to overcome this difference) is not new [36], but the limits of our capitalist consumerist way of life were pointed out, for the first time, by the so-called The Club of Rome [37]. Then, many authors [38,39] have argued the basis of iniquities are in our way of life itself. E.g. Schumacher already pointed out another way of life is possible in his little essay *Small is beautiful* [40]. This author presented the idea that other ways of development were not only possible, but probably will make us happier. Small things meant other ways of living, and this work opened the door to new concepts, such as alter-development, appropriate technology or endogenous development. That is, the fundamentals of a sustainable way of growing.

Merging development cooperation and equity and global ethics drove the academic community to a whole vision of how the role of each person is inside an interconnected world [41]. That is, *global citizenship* [42]. People on Earth, no matter where exactly one lives (north or south, developed or developing countries, urban or rural space, etc.) no matter if one belongs to a particular group or community (men-women; hetero-homosexual; religious-atheist, etc.), the only fact of being human constitutes an ontological status of moral, ethical and even political law. In other words, global ethics met developing cooperation and founded a new vision of citizenship: Global citizenship and human development. These are the reasons in which authors as Sen [43] or Nussbaum [44] expanded the vision of human rights to human capabilities. Sustainability was not only caring for the environment, but a need for redefining key concepts, such as justice and equity. In the same way as Walzer or Sandel, Cortina's proposal Minimum Ethics [42] tried to build up a moral structure valid for everyone at a world scale.

Finally, looking deeper into Schumacher's proposal [40], a deeper suggestion can be identified. When this author argued that small is beautiful (in clear opposition with the capitalist statement that *bigger (more) is always better*) a new path, spiritual aspect, is given. Schumacher is telling us that we can live in a happier way if we try to possess less, to use less, to retain less. In some way, this is the first-time human happiness (human wellness) appears linked to our relationship toward a limited Earth. Nowadays, this can be clearly presented in the recent Laudato Si' encyclical [45] or in the public policies from the Ecuatorian Government on Sumak Kawsay (the *good living*) [46]. This is a subjective vision, but they probably can be considered the origins of sustainability as an integral concept [47,48].

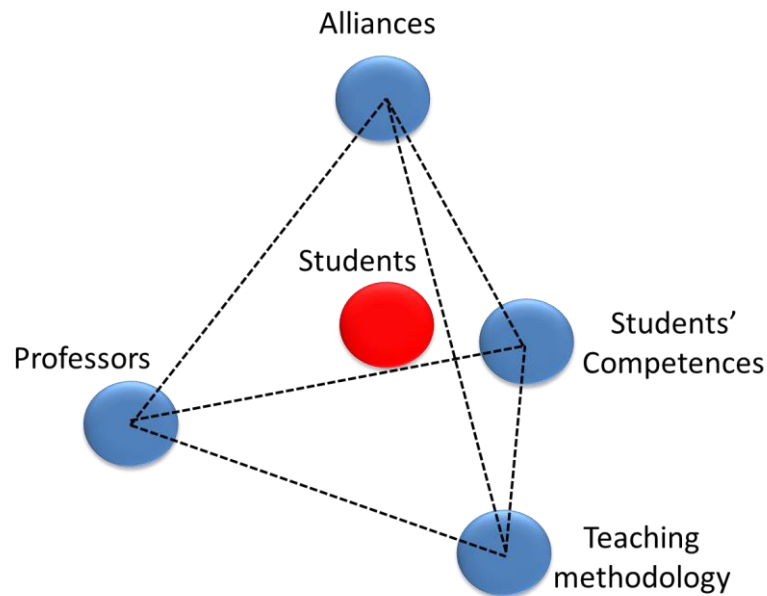
How to stay away from sustainability new paradigm, which has to do with a new cosmivision of human relationship? As some authors have already pointed out (see Figure 1 above), sustainability is something that connects human beings through solidarity links: At present, solidarity amongst different countries and populations (so-called South and North, developed and less developed, poor and rich); towards the future generations by as we are committed "to meet the needs and aspirations of the present without compromising the ability to meet those of the future" [49] (p. 40). Solidarity understood as a way of social and civic organization is then a teachable objective of Ortega's university vision, able to be included in the curricula and in the common activity of the Higher Education, which is, teaching [50].

Consequently, the university must be aware of this broader vision that could probably develop new relationships with nature and between human beings, reaching almost every dimension of society, because it involves the entire relationship between human beings and nature [13]. In this sense, the SDGs are an opportunity to extend the concept of sustainable development in the university [12,32].

## 5. Framework to Teach SDG at University

In order to include the teaching of sustainability, under the paradigm of SDG in the university, a framework is needed. Presenting a universal framework is certainly a difficult task [12] and will require further contextualization to the particular circumstances of each context. Figure 2 shows a schematic representation of it. It has five components; in the gravity center of the tetrahedron are the

students. They should be at the center of the teaching-learning process [20]. In each of the vertexes of the tetrahedron are the rest of the components of the framework (student's competences, teaching methodology, professors and alliances). In the following sections, these elements will be described. Finally, the applicability of such a framework will be checked by proposing a specific and particular case study in the Primary Teacher Degree.



**Figure 2.** Proposed framework to teach SDGs at the university.

### 5.1. Students

Today, students should be at the center of the teaching and learning process. If previously, university teaching was focused on content development, now the focus is on students [51–53]. For example, in the European context, the teaching load is measured in terms of the workload of the student, including face-to-face activities (magisterial lessons, laboratories, computer classes) and personal workload (study, time for activities, and so on) [51,54]. This is a key aspect in order to teach SDG at university classrooms. Firstly, teachers need to know the real needs of students. What are their centers of interest? What is their previous knowledge? What are their socio-economic characteristics? In this way, it is likely that there will not be fully universal solutions and that a particularization will be necessary for each particular context. Secondly, the workload must be carefully estimated to meet expectations [55,56]. The success of the initiatives that will be implemented must take into account the needs, expectations and characteristics of the students [4,32]. In the case we are working on, sustainability and SDGs should be included in the curricular development under the specific student's interest. This could be an easy task to work on, bearing in mind the large number of implications sustainability as an integral concept presents (see Section 4 above).

For a correct alignment with the SDGs, and following the maxim of “leave no one behind”. In the design of teaching-learning activities, people with difficulties should be taken into account (e.g., low-income students, students with disabilities, immigrants, refugees, etc.). Are programed activities accessible to everyone? Are there barriers to students being able to do all the activities? For example, in degrees, such as architecture there are some activities that have a cost outside of tuition; i.e., visits to buildings in other parts of the country or the world, or the making of models. In our opinion, on these occasions, apart from an adequate scholarship policy, the teacher must be aware of the needs of the students and ensure that everyone has equal access to opportunities.

## 5.2. Student's Competences

One of the aspects that should be reflected upon is about the competences that should be developed in the learning-teaching process. By competence, we mean the integration of knowledge, skills and attitudes to a particular situation [51,52]. Learning outcomes at different stages of education refer to competences [16,57,58]. In a world of profound change, no one really knows what the skills required are going to be in the future [59]. In fact, it is said that a large part of the professions of the future does not exist today. In this sense, university education traditionally focused on the development of professional skills is undergoing a deep crisis. In this context, transversal skills play an important role [58,59]. In previous works [20,57,60,61], we have reflected on the importance of developing specific competences (directly related to the profession) and transversal competences, those that are related to the profession are also related to the development of critical citizenship, in the university environment. Some experts [59,62,63] bet on the development of the 4 C's: Communication, collaboration, critical thinking, and creativity.

In our opinion, this landscape certainly favors the development of SDGs in the university environment. Firstly, because these activities can contribute to the development of transversal skills, such as critical thinking, development of ethical skills, etc. On the other hand, they make it possible to develop technical skills that are at the forefront. For example, SDG 7 seeks the use of clean and affordable energy. An approach to this objective in university classrooms requires first of all explaining the different sources of renewable energy and also the consequences of not using this type of energy (specific competences), on the other hand, transversal skills can be developed, such as ethical skills (consequences of non-renewable energies), creativity (research into new sources), and so on. Finally, dealing with SDGs make the students think about the future world, the only world they will have to work in. Therefore, the articulation of specific and transversal competences in the teaching of SDGs is a challenge and an opportunity.

## 5.3. Teaching Methodology

The teaching methodology is the third element of the proposed conceptual framework. In a recent work, Lozano et al. (2017) [16] explored the relationship that should be articulated between the field of competences and the methodologies that should be used for their development in sustainability education. Most of the methodologies proposed in the teaching of the Sustainable Development Goals are based on constructivism [64–66]. In this approach, the student is the center of the process of teaching-learning—it is sought that the students construct the knowledge [64–66]. One of the important aspects of constructivism is its social dimension; students learn by working with others [20]. Based on those proposed for education for sustainable development [67], there are different strategies for teaching SDGs [12]. For example, the inclusion of a course on SDGs or creation of specialties in the form of itineraries that promote the development of SDGs., these options may be interesting for master's degrees, however, they quite difficult in bachelor's degrees; other more viable options are: The integration within the subjects' themes, the inclusion of a specific topic about the SDGs in some subjects or the development of a transversal way in different subjects of the degree. In this sense, some experiences have been described; for example, Albareda-Tiana et al. analyzed how to develop sustainability competencies in future teachers [68]. The development of works in the field of the Master in Thermal Engineering has been presented by Crespo et al. [69]. The Conference of Vice-chancellor of Spanish universities indicated that service-learning could be a tool for the development of sustainability in the university context [32,70]. Other authors have reflected on using Participatory Action Research to promote sustainability and SDGs [14]. Furthermore, in previous works, it has been defended that the final master/degree dissertations can be a very interesting tool for the development of this type of competences [55,71].

Some universities are beginning to make libraries of the experiences of promotion of SDGs in the field of teaching. For example, the University of Toronto has recently carried out an inventory that includes subjects—community-engaged learning and co-curricular and extra-curricular activities [72].

Another experience was carried out by Albareda-Tiana et al. [32]; in this paper, the curricula of the International University of Catalonia were analyzed in order to find the relationship between the subjects and the SDGs. This information was completed with interviews with deans or directors.

#### 5.4. Professors

The center of the teaching activity should be the students, in order to achieve success. However, around the students should orbit crucial actors, the professors. They are so important and relevant in the whole teaching-learning process because they organize the teaching activity and program the learning plan [73]. A recent paper by Walter et al. pointed out the reasons that academics found for not including SDGs in their activity, including lack of training, lack of opportunities, lack of materials and lack of time [12]. For this reason, it is essential to train them, motivate them and value the activities related to the integration of SDGs in the university curriculum [12,32]. The description of the committed with sustainable education teachers' profiles has been published elsewhere [10]. In order to implement the SDGs development and promote sustainability, it is crucial to increase the social mass of committed teachers [10].

On the other hand, activities promoting sustainability have traditionally not been valued in teachers' curricula [12,74]. In fact, one of the issues that has been denounced has been the lack of support for this type of initiative [12,74]. Professors involved in such initiatives sometimes work in an uncoordinated manner and suffer from isolation. This is why it is crucial to create collaborative networks between teachers and connect them with other actors involved in the development of SDGs [74]. In this sense, in our opinion, it is urgent to create learning communities that on the one hand seek the training of teachers and on the other constitute a coordination space that includes the affective dimension among teachers interested in the development of SDGs. The working itinerary of the Teaching Innovation Group "Teacher Ethics" of the University of Extremadura (Spain) may serve as an example [61]. The group is formed by professors from different disciplines interested in the inclusion of ethics in a transversal way in the university curriculum [61]. The main key to the formation of the group was a constructivist approach to learning by doing [61]. In this way, the training activities (courses and conferences) were complemented with classroom interventions and periods of reflection and communication of the initiatives among the teachers of the group [61]. The structure of these working groups should be flexible enough to allow teachers to be involved with varying degrees of intensity. In this way, a driving group, formed by a small group of teachers, around this group a group of people committed to the project, finally on the periphery a group of interested people who will collaborate with the group in a timely manner [61].

#### 5.5. Alliances

One of the keys to the SDGs is that it requires the participation of all actors [74,75] in a multidisciplinary work [8]. In order to achieve them, it is necessary that all stakeholders: Administrations, civil society, companies, etc. work in a coordinated manner [74].

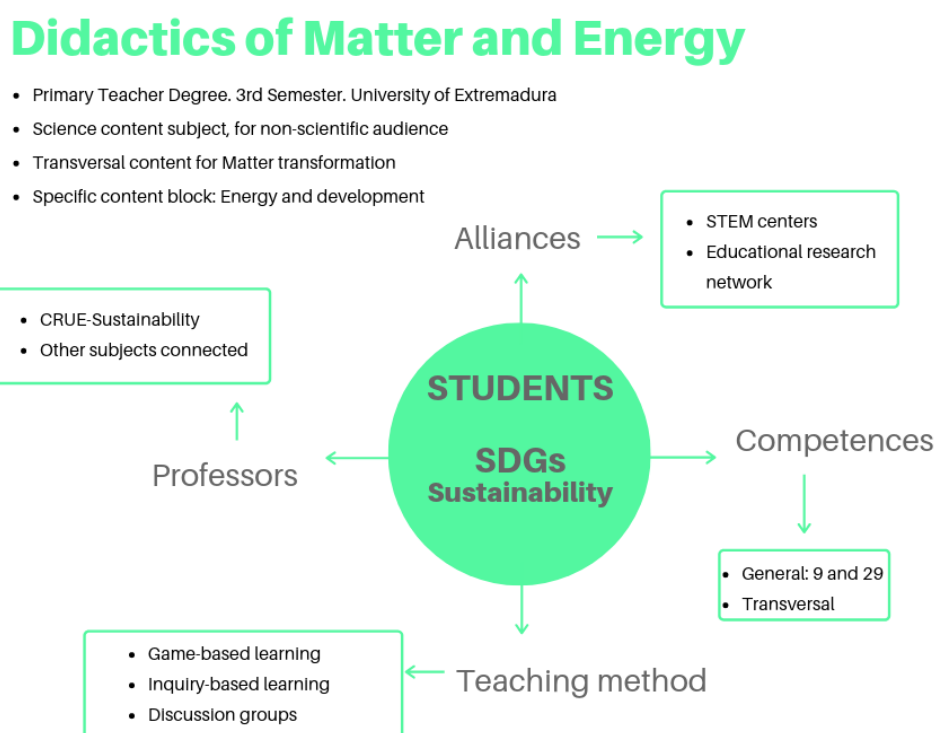
The creation of alliances is crucial for the development of SDGs at the university [9]. On the one hand, alliances between universities are necessary, as well as alliances and coordinated work between universities and other actors, such as the administration, non-governmental organizations and even companies. In the field of promoting sustainability in higher education, we can point to action as an example of good practice. Global Dimension Engineering Education (GDEE). It was an initiative, funded by European Union, that seeks to develop the skills of teachers in the field of higher education, the creation of networks of teachers and researchers related to these issues and the connection between professionals in the field of higher education and non-governmental organizations [74,76]. Other initiatives, such as the education for development strategy of Valencia (Spain) invite collaboration between all actors, taking into account the university [77]. In any case, the university must, therefore, be attentive to the needs of society and try to promote mutual exchange and collaboration.



## 6. A Case Study Using this Framework—How to Introduce SDGs Teaching in a Standard Degree Subject: Didactics of Matter and Energy

As an initial approach for applying the current conceptual framework proposal, we present a full adaptation of a current course called Didactics of Matter and Energy. In this study case, the application of the proposed framework is qualitatively analyzed. This course is taught inside the Primary Teacher Degree, specifically in the second year (third semester). The complete syllabus of such course is available on the University of Extremadura website [78], but in this work, we will summarize some aspects that can be relevant for adapting this subject to a transversal path of promoting/teaching on SDGs.

Figure 3 is a graphical abstract of the following reflections that are made on the basis of Section 5 above. We focus and particularize the previous dimensions (Students, Competences, Professors, Teaching methodology and Alliances) in this course, in its academic contents and in its methodological approach.



**Figure 3.** A schematic representation of the applicability of the proposed framework to Didactics of Matter and Energy subject.

As a first approach, one must bear in mind the fact that, in the particular case of Didactics of Matter and Energy, we are dealing with non-scientific students, as we stated out elsewhere [79,80]. This forces us to make this subject as attractive as possible, mainly by means of connecting the contents we have to teach to transversal and multi-center objectives. In this sense, sustainability, human development and SDGs can possibly be interest centers for the students because of three reasons:

1. They are daily breaking news, and their linking to the quotidian life is more than evident;
2. They are easy to relate to transversal contents, such as environmental caring, which is of first-line interest for prospective teachers like the students we are dealing with;
3. Lastly, they allow many other subjects, not strictly scientific (such as world development, the role of science education or gender issues) that are softer to understand.

On the other hand, in previous studies, we have studied the knowledge that education students had about SDGs [4]. Knowledge of SDGs was quite limited, similar to that obtained in other engineering or health sciences degrees [4]. Regarding the student's competences, this subject allows specifically two general competences (those linked to the degree) that can easily be connected to SDGs. These ones are the following, according to the syllabus [78]:

*General Competence 9: To evaluate the individual and collective responsibility towards a sustainable future.*

*General Competence 29: To acknowledge the mutual influence between science, society and technological development, as well as the adequate citizen behaviors to manage a sustainable future.*

As can be easily appreciated, from both general competences other transversal ones are distilled, such as those related to global Earth-scale ethical rules. These competences can be easily adapted for being achieved through SDGs development.

Furthermore, we cannot forget we are dealing with prospective primary teachers. The teaching methodology we use is the content itself; students learn to teach in the classes of the subject. This is why other General Competences are related to educative resources (GC 30) or with the primary syllabus of sciences (GC 26). Specifically, the use of new and active teaching methodologies appears at the transversal competence 2.4, where the subject syllabus stated out:

*Transversal competence 2.4: To keep an innovation attitude and creativity toward the teaching activity.*

In this sense, activities based on active learning methodologies, such as gamification [80] or inquiry-based can be of great help. Moreover, the UN has released a specific game for SDGs knowledge, free and open access [81]. Since we are working with adult and reflective students, we cannot dismiss the discussion sessions, where aspects, such as global social justice ("no one behind"), should be focused.

Didactics of Matter and Energy, if taught under the vision of SDGs, integral ecology and sustainability, needs for a specific motivation within the professors. If sustainability, understood as said above, is the leitmotiv of this subject, one must go beyond the particular contents. How to explain chemical reactions (in general) by including a specific speed on, for example, acid rain? This can be not an easy task, so reinforcements and resources sharing could be of interest. In this sense, there are already several teaching nets that can help us with this. As an example, the case of Working Team for Curricular Sustainability of Spanish Vice-chancellors' Conference (CRUE) [82] tries to include all these issues in the standard way of teaching for several knowledge disciplines, especially those related to science education.

Additionally, professors can be helped in their work if sustainability is included not only in one subject, but in several ones that are already interconnected. This is the case, in Primary Education Degree, of Didactics of Living Beings (6th semester) or Knowledge of Natural Environment in Primary Education (7th semester).

Finally, as we stated in the general framework, alliances are needed to reinforce the work inside the university. As a matter of fact, alliances can be of help in two complementary directions:

On the one hand, they can give sense to the theoretical or not-so-applied knowledge we teach inside the classroom. This is the case of connecting with recreational science institution [83] that are usually working with Science Technology Engineering and Mathematics (STEM) or Science Technology Engineering Arts and Mathematics (STEAM) issues.

On the other hand, the professional network can help, as a specific alliance, to valorize the educational research work of the professors. This is absolutely needed to guarantee the continuity of such interest. The care of teaching and learning activity must be supported by an institutional recognition, especially within those university teachers that are focused (in research terms) in education. That is the importance of national initiatives, such as Edinsost [84], where higher education teachers connect each other's to promote sustainable education, publish results and share intuitions.

## 7. Conclusions

Universities can play a crucial role in the development of Sustainable Development Goals and the promotion of sustainability. In the current paper, we have reflected on the evolution of the concept of sustainability and how it can be reinterpreted under the umbrella of the Sustainable Development Goals.

The concept of sustainability is complex and polyhedral, the historical evolution of the concept has been shown, and it has been justified its approach from the university context, primarily from the teaching field. Most of the works published so far refer to research and development of sustainable campuses.

A framework has been proposed for the teaching of SDGs in the university context. The proposed framework has five dimensions: Students, student competencies, teachers, teaching methodologies and alliances with other actors. The inclusion of SDGs in the university environment should have each of these dimensions for its development.

This work contributes to scientific knowledge in two dimensions. On the one hand, it analyzes the concept of sustainability within the framework of the SDGs. On the other hand, the work incorporates a conceptual framework that will allow future researchers and teachers to develop and implement activities aimed at promoting SDGs at the university. In the future, the framework should be evaluated in terms of practical implementation in the classroom.

The following lines of future work are drawn from the work developed:

1. It is necessary that actions to promote sustainability and the objectives of sustainable development have sufficient protection from the universities themselves and from the administrations (top-down support) [12,72]. Sometimes the work of professors is not valued enough. It is, therefore, necessary to carry out advocacy work with managers and politicians so that this issue falls within the broad guidelines of the university;
2. The previous strategy must be matched with a bottom-up approach [12]. In this way, collaborative action by all members of the university community (students, staff, researchers and professors) can contribute to the promotion of sustainability and compliance with the SDGs;
3. Finally, it is necessary to make an effort to document the experiences developed and make inventories of them. In many subjects, there are experiences aimed at promoting sustainability that goes unnoticed because they have not been conveniently compiled and narrated.

This work is part of a broader project that seeks to promote the SDGs transversally throughout the university curriculum. In a previous work we evaluated students' knowledge of SDGs [4]; in this paper, we propose a framework to teach SDGs at university. The next work will be aimed at the development of classroom activities that enable better training of students in this field. From the analysis of these experiences, the framework proposed by this article should be reviewed, evaluated and improved where necessary.

**Author Contributions:** This work is the result of the collaboration between all authors. All authors have equally contributed, reviewed, and improved the manuscript. All authors have revised and approved the final manuscript.

**Funding:** This work was financed by Research Projects EDU2016-77007-R (AEI/FEDER, UE) of the Ministry of Economy and Competitiveness of Spain, and by Research Project IB 16068 and GR18004 of the Regional Government of Extremadura, partially funded by the European Regional Development Fund.

**Acknowledgments:** Authors thank M. Guerrero-González for her comments and suggestions on the preliminary versions of the manuscript.

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

## References

1. General Assembly of United Nations. Transforming Our World: The 2030 Agenda for Sustainable Development. Resolution Adopted by the General Assembly on 25 September 2015. Available online: [http://www.un.org/ga/search/view\\_doc.asp?symbol=A/RES/70/1&Lang=E](http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E) (accessed on 7 November 2018).

2. Spanish Government. *Action Plan for the Implementation of Agenda 2030. Towards a Spanish Sustainable Development Strategy*; Spanish Government: Madrid, Spain, 2018.
3. Dlouhá, J.; Pospíšilová, M. Education for Sustainable Development Goals in public debate: The importance of participatory research in reflecting and supporting the consultation process in developing a vision for Czech education. *J. Clean. Prod.* **2018**, *172*, 4314–4327. [[CrossRef](#)]
4. Zamora-Polo, F.; Sánchez-Martín, J.; Corrales-Serrano, M.; Espejo-Antúnez, L. What Do University Students Know about Sustainable Development Goals? A Realistic Approach to the Reception of this UN Program Amongst the Youth Population. *Sustainability* **2019**, *11*, 3533. [[CrossRef](#)]
5. Sen, A. *Development as Freedom*; Oxford University Press: Oxford, UK, 1999; ISBN 9780192893307.
6. UNDP. *Human Development Report 2011. Sustainability and Equity: A Better Future for All*; UNDP: New York, NY, USA, 2011; ISBN 9780230363311.
7. Boni, A.; Lopez-Fogues, A.; Walker, M. Higher education and the post-2015 agenda: A contribution from the human development approach. *J. Glob. Ethics* **2016**, *12*, 17–28. [[CrossRef](#)]
8. Gusmão Caiado, R.G.; Leal Filho, W.; Quelhas, O.L.G.; Luiz de Mattos Nascimento, D.; Ávila, L.V. A literature-based review on potentials and constraints in the implementation of the sustainable development goals. *J. Clean. Prod.* **2018**, *198*, 1276–1288. [[CrossRef](#)]
9. Owens, T.L. Higher education in the sustainable development goals framework. *Eur. J. Educ.* **2017**, *52*, 414–420. [[CrossRef](#)]
10. Lazzarini, B.; Pérez-Foguet, A. Profiling research of the engineering academics who successfully promote education in Sustainable Human Development. *J. Clean. Prod.* **2018**, *172*, 4239–4253. [[CrossRef](#)]
11. Yáñez, S.; Uruburu, Á.; Moreno, A.; Lumbreras, J. The sustainability report as an essential tool for the holistic and strategic vision of higher education institutions. *J. Clean. Prod.* **2019**, *207*, 57–66. [[CrossRef](#)]
12. Leal Filho, W.; Shiel, C.; Paço, A.; Mifsud, M.; Ávila, L.V.; Brandli, L.L.; Molthan-Hill, P.; Pace, P.; Azeiteiro, U.M.; Vargas, V.R.; et al. Sustainable Development Goals and sustainability teaching at universities: Falling behind or getting ahead of the pack? *J. Clean. Prod.* **2019**, *232*, 285–294. [[CrossRef](#)]
13. Martínez-Martínez, J.L. Ética en la universidad: El horizonte de la Agenda 2030 y de la Ecología Integral. *Razón y Fe* **2019**, *279*, 285–298.
14. Trott, C.; Weinberg, A.; Sample McMeeking, L. Prefiguring Sustainability through Participatory Action Research Experiences for Undergraduates: Reflections and Recommendations for Student Development. *Sustainability* **2018**, *10*, 3332. [[CrossRef](#)]
15. Palmer, R.E. *Hermeneutics: Interpretation Theory in Schleiermacher, Dilthey, Heidegger, and Gadamer*; Northwestern University Press: Evanston, IL, USA, 1969; ISBN 9780810100275.
16. Lozano, R.; Merrill, M.; Sammalisto, K.; Ceulemans, K.; Lozano, F. Connecting Competences and Pedagogical Approaches for Sustainable Development in Higher Education: A Literature Review and Framework Proposal. *Sustainability* **2017**, *9*, 1889. [[CrossRef](#)]
17. Heidegger, M. *Sein und Zeit (Ser y Tiempo)*; Trotta: Madrid, Spain, 2009; ISBN 9788498790474.
18. Succar, B. Building information modelling framework: A research and delivery foundation for industry stakeholders. *Autom. Constr.* **2009**, *18*, 357–375. [[CrossRef](#)]
19. Anfara, V.A.J. Theoretical Frameworks. In *The SAGE Encyclopedia of Qualitative Research Methods*; SAGE Publications, Inc.: Thousand Oaks, CA, USA, 2008; ISBN 9781412941631.
20. Zamora-Polo, F.; Luque-Sendra, A.; Sánchez-Martín, J.; Aguayo-González, F. Conceptual Framework for the Use of Building Information Modeling in Engineering Education. *Int. J. Eng. Educ.* **2019**, *35*, 744–755.
21. Walzer, M. *Las Esferas de la Justicia: Una Defensa del Pluralismo y la Igualdad*; Fondo de Cultura Económica: México D.F., Mexico, 1983; ISBN 9789681663940.
22. Gadotti, M. What We Need to Learn to Save the Planet. *J. Educ. Sustain. Dev.* **2008**, *2*, 21–30. [[CrossRef](#)]
23. Kuhn, T.S. *The Structure of Scientific Revolutions*, 3rd ed.; University of Chicago Press: Chicago, IL, USA, 1962; ISBN 9780226458083.
24. Connell, R.W. Citizenship, Social Justice and Curriculum. *Int. Stud. Sociol. Educ.* **1992**, *2*, 133–146. [[CrossRef](#)]
25. Marcuse, H. *One-Dimensional Man*; Routledge: Abingdon, UK, 2013; ISBN 9780203995211.
26. Bauman, Z. *Work, Consumerism and the New Poor*; McGraw-Hill Education: New York, NY, USA, 2004; ISBN 978033521598X.
27. Seghezze, L. The five dimensions of sustainability. *Environ. Politics* **2009**, *18*, 539–556. [[CrossRef](#)]
28. Ortega-y-Gasset, J. *Misión de la Universidad*; Cátedra: Madrid, Spain, 2015; ISBN 9788437633575.

29. Hortal, A. *Ética General de las Profesiones*; Desclée De Brouwer: Bilbao, Spain, 2002; ISBN 9788433017185.
30. Cortina, A. La Universidad republicana. *País* **2001**, *18*, 129–154.
31. Pedrajas, M. La Última Milla: Los desafíos éticos de la pobreza extrema y la vulnerabilidad en la Agenda 2030 para el Desarrollo Sostenible de Naciones Unidas. *Veritas* **2017**, *37*, 79–96. [[CrossRef](#)]
32. Albareda-Tiana, S.; Vidal-Raméntol, S.; Fernández-Morilla, M. Implementing the sustainable development goals at University level. *Int. J. Sustain. High. Educ.* **2018**, *19*, 473–497. [[CrossRef](#)]
33. Carson, R. *Silent Spring*; Houghton Mifflin Company: Boston, MA, USA, 1962; ISBN 9780618249060.
34. World Commission on Environment and Development. Our Common Future—Report of the World Commission on Environment and Development (The Brundtland Report). *Med. Confl. Surviv.* **1987**. [[CrossRef](#)]
35. General Assembly of United Nations United Nations Millennium Declaration. Available online: <https://www.un.org/millennium/declaration/ares552e.pdf> (accessed on 23 July 2019).
36. Chenery, H.; Ahluwalia, M.S.; Bell, C.L.G.; Duloy, J.H.; Jolly, R. *Redistribution with Growth: Policies to Improve Income Distribution in Developing Countries in the Context of Economic Growth*. World Bank and the Institute of Development Studies, University of Sussex; Oxford University Press: London, UK; Washington, DC, USA, 1974; ISBN 9780199200696.
37. Meadows, D.H.; Meadows, D.L.; Randers, J.; William, B.I.W. *The Limits to Growth. A Report for the Club of Rome's Project on the Predicament of Mankind*; Universe Books: Washington, DC, USA, 1972; ISBN 9780876631650.
38. Castoriadis, C. *Une Société à la Dérive, Entretiens et Débats 1974–1997, Préparée par E*; Éditions du Seuil: Paris, France, 2005; ISBN 9782020788533.
39. Taibo, C. *En Defensa del Decrecimiento: Sobre Capitalismo, Crisis y Barbarie*; Los Libros de la Catarata: Madrid, Spain, 2009; ISBN 9788483195215.
40. Schumacher, E.F. *Small is Beautiful: A Study of Economics as if People Mattered*; Blond & Briggs: London, UK, 1973; ISBN 9781446468364.
41. Ohmae, K. *The Borderless World. Power and Strategy in the Global Marketplace*; Harper Collins: London, UK, 1994; ISBN 9781861975843.
42. Cortina, A. *Ética Mínima. Una Introducción a la Filosofía Práctica*; Tecnos: Madrid, Spain, 2000; ISBN 9788430934715.
43. Sen, A. *Inequality Reexamined*; Oxford University Press: Oxford, UK, 1992; ISBN 9780674452565.
44. Nussbaum, M.C. *Women and Human Development*; Cambridge University Press: Cambridge, UK, 2000; ISBN 9780511841286.
45. Francis, P. *Encyclical Letter Laudato Si' of the Holy Father Francis on Care for Our Common Home*; Vatican Typography: City of Vatican, Vatican, 2015.
46. Ecuador Constituent Assembly Assembly Constitution of the Ecuatorian Republic. Available online: [https://www.asambleanacional.gob.ec/sites/default/files/documents/old/constitucion\\_de\\_bolsillo.pdf](https://www.asambleanacional.gob.ec/sites/default/files/documents/old/constitucion_de_bolsillo.pdf) (accessed on 31 July 2019).
47. Boff, L. *Ecology: A Claim from Earth, a Claim from Poors (Ecología: Grito de la Tierra, Grito de los Pobres)*; Trotta: Madrid, Spain, 2011; ISBN 9788498792324.
48. Louv, R. *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*; Algonquin Books: Chapel Hill, NC, USA, 2008; ISBN 9781565126053.
49. WCED. *Our Common Future—The Brundtland Report*; WCED: Cape Town, South Africa, 1987.
50. Lozano, R.; Young, W. Assessing sustainability in university curricula: Exploring the influence of student numbers and course credits. *J. Clean. Prod.* **2013**, *49*, 134–141. [[CrossRef](#)]
51. Zamora-Polo, F.; Sánchez-Martín, J.; Hipólito-Ojalvo, F. Using moral dilemma for ethical skills development in engineering degrees. Application to mechanical engineering. *Dyna Ing. Ind.* **2016**, *91*, 495–497. [[CrossRef](#)]
52. Mateos, V.L.; Montanero, M.; Gómez, V.; Salamanca, S. *Diseño e Implantación de Títulos de Grados en el Espacio Europeo de Educación Superior*; Ediciones Narcea: Madrid, Spain, 2008; ISBN 9788427716292.
53. Foster, G.; Stagl, S. Design, implementation, and evaluation of an inverted (flipped) classroom model economics for sustainable education course. *J. Clean. Prod.* **2018**, *183*, 1323–1336. [[CrossRef](#)]
54. Zamora-Polo, F. The European space of higher education, an opportunity for ethical learning in industrial engineering. *Dyna* **2009**, *35*, 744–755.
55. Román-Suero, S.; Sánchez-Martín, J.; Zamora-Polo, F. Opportunities given by final degree dissertations inside the EHEA to enhance ethical learning in technical education. *Eur. J. Eng. Educ.* **2013**, *38*, 149–158. [[CrossRef](#)]

56. Zhang, S.; Sulankivi, K.; Kiviniemi, M.; Romo, I.; Eastman, C.M.; Teizer, J. BIM-based fall hazard identification and prevention in construction safety planning. *Saf. Sci.* **2015**, *72*, 31–45. [CrossRef]
57. Zamora-Polo, F.; Román-Suero, S.; Sánchez-Martín, J. From Efficiency to sustainability. Training responsible engineers in the new educational scene. *Dyna Ing. Ind.* **2010**, *85*, 575–580. [CrossRef]
58. Sá, M.; Serpa, S. Transversal Competences: Their Importance and Learning Processes by Higher Education Students. *Educ. Sci.* **2018**, *8*, 126. [CrossRef]
59. Harari, Y.N. *21 Lessons for the 21st Century*; Random House: New York, NY, USA, 2018; ISBN 9781473554713.
60. Zamora-Polo, F.; Sánchez-Hernández, M.I.; Gallardo-Vázquez, D.; Hipólito-Ojalvo, F. Formando ciudadanos comprometidos. Fomento de la responsabilidad social en los universitarios. *Rev. Interuniv. Form. Profr.* **2014**, *28*, 51–62.
61. Sánchez-Martín, J.; Zamora-Polo, F.; Moreno-Losada, J. Including ethical learning and moral reasoning aspects in higher education: A proposal for developing ethical competences in the university. In *Business Intelligence, Strategies and Ethics*; Nova Science Publishers: New York, NY, USA, 2015; pp. 105–125. ISBN 9781634820646.
62. Davidson, C.N. *The New Education: How to Revolutionize the University to Prepare Students for a World in Flux*; Hachette: New York, NY, USA, 2017; ISBN 9780465093183.
63. Kivunja, C. Teaching Students to Learn and to Work Well with 21st Century Skills: Unpacking the Career and Life Skills Domain of the New Learning Paradigm. *Int. J. High. Educ.* **2014**, *4*. [CrossRef]
64. Carey, S.; Zaitchik, D.; Bascandziew, I. Theories of development: In dialog with Jean Piaget. *Dev. Rev.* **2015**, *38*, 36–54. [CrossRef]
65. Bruner, J.S. The act of discovery. *Harv. Educ. Rev.* **1961**, *31*, 21–32.
66. Ausubel, D.P.; Novak, J.; Hanesian, H. *Educational Psychology: A Cognitive View*; Rinehart and Winston: New York, NY, USA, 1978.
67. Lozano, F.J.; Lozano, R. Developing the curriculum for a new Bachelor's degree in Engineering for Sustainable Development. *J. Clean. Prod.* **2014**, *64*, 136–146. [CrossRef]
68. Albareda-Tiana, S.; Vidal-Raméntol, S.; Pujol-Valls, M.; Fernández-Morilla, M. Holistic approaches to develop sustainability and research competencies in pre-service teacher training. *Sustainability* **2018**, *10*, 3698. [CrossRef]
69. Crespo, B.; Míguez-Álvarez, C.; Arce, M.E.; Cuevas, M.; Míguez, J.L. The Sustainable Development Goals: An Experience on Higher Education. *Sustainability* **2017**, *9*, 1353. [CrossRef]
70. CRUE-Comisión de Sostenibilidad Institucionalización del Aprendizaje-Servicio como Estrategia Docente Dentro del Marco de la Responsabilidad Social Universitaria para la Promoción de la Sostenibilidad en la Universidad. Available online: <https://www.crue.org/Documentoscompartidos/Recomendacionescriteriostecnicos/2.APROBADAINSTITUCIONALIZACIONApS.pdf> (accessed on 31 July 2019).
71. Zamora-Polo, F.; Sánchez-Martín, J. Los Trabajos Fin de Grado: Una herramienta de desarrollo de competencias transversales en la Educación Superior. *REDU Rev. Docencia Univ. Docencia Univ.* **2015**, *13*, 197–211. [CrossRef]
72. Brugmann, R.; Côté, N.; Postma, N.; Shaw, E.; Pal, D.; Robinson, J. Expanding Student Engagement in Sustainability: Using SDG- and CEL-Focused Inventories to Transform Curriculum at the University of Toronto. *Sustainability* **2019**, *11*, 530. [CrossRef]
73. Mellado, V.; Borrachero, A.B.; Brígido, M.; Melo, L.V.; Dávila, M.A.; Cañada, F.; Conde, M.C.; Costillo, E.; Cubero, J.; Esteban, R.; et al. Emotions in science teaching | Las emociones en la enseñanza de las ciencias. *Enseñanza Cienc.* **2014**, *32*, 11–36. [CrossRef]
74. Lazzarini, B.; Pérez-Foguet, A.; Boni, A. Key characteristics of academics promoting Sustainable Human Development within engineering studies. *J. Clean. Prod.* **2018**, *188*, 237–252. [CrossRef]
75. Sachs, J.D. From Millennium Development Goals to Sustainable Development Goals. *Lancet* **2012**, *379*, 2206–2211. [CrossRef]
76. GDEE. Global Dimension Engineering Education Web Page. Available online: <http://gdee.eu/> (accessed on 31 July 2019).
77. Boni, A.; Belda-Miquel, S.; Calabuig-Tormo, C.; Millán-Franco, M.A.; Talón-Villacañas, A. Adaptando los ODS a lo Local mediante la Educación para el Desarrollo. La Experiencia de la Estrategia de la Ciudad de Valencia. *Rev. Int. Educ. Justicia Soc.* **2019**, *8*, 117. [CrossRef]

78. Cañada-Cañada, F.; Bravo-Galán, J.L.; Sánchez-Martín, J.; Muñoz-Losa, A.; González-Gómez, D.; Guerra-Sánchez-Simón, M.T. Syllabus of Didactics of Matter and Energy. Available online: <https://www.unex.es/conoce-la-uex/centros/educacion/titulaciones/info/assignaturas?id=0617> (accessed on 23 July 2019).
79. Sanchez-Martin, J.; Cañada-Cañada, F.; Dávila-Acedo, M.A. Emotional responses to innovative Science teaching methods: Acquiring emotional data in a General Science teacher education class. *J. Technol. Sci. Educ.* **2018**, *8*, 346. [[CrossRef](#)]
80. Sánchez-Martín, J.; Cañada-Cañada, F.; Dávila-Acedo, M.A. Just a game? Gamifying a general science class at university: Collaborative and competitive work implications. *Think. Ski. Creat.* **2017**, *26*, 51–59. [[CrossRef](#)]
81. UNRIC; Ait Kaci, Y. Go Goals: A board game on SDGs. Available online: [www.go-goals.org](http://www.go-goals.org) (accessed on 23 July 2019).
82. CRUE-Comisión de Sostenibilidad Sustainability Commission Web Page. Available online: <http://www.crue.org/SitePages/Sostenibilidad.aspx> (accessed on 23 July 2019).
83. Experiment Web Page of Experiment, an Interactive Center of Science. Available online: <https://experimenta-cic.com/> (accessed on 23 July 2019).
84. UPC. Edinsost, a Project on Educative Innovation. Available online: <https://is.upc.edu/es/noticias/edinsost> (accessed on 23 July 2019).



© 2019 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).