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Analysis of Sustainability Knowingness, Attitudes and Behavior of a Spanish Pre-Service Primary Teachers Sample

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Abstract: In the context of climatic emergency, teaching for sustainability is crucial to transform damaging behavioral social paths into sustainable ones. In this contribution, we focus on the relevance of the Degree in Primary Education to reach this change, assessing through the Sustainability Consciousness Questionnaire (SCQ) the sustainability awareness of a sample of 151 students of this bachelor's degree. SPSS and JASP statistical programs were used for data analyses and graphical representations. The results support that this test is appropriate to estimate the different dimensions of sustainability consciousness of Spanish pre-service primary teachers. Specifically, we found that these students assign higher scores to items of sustainability knowingness and sustainability attitudes above all in the social dimension. Some gender differences are found in sustainability behavior, which is higher in the male subset for the economic dimension. Correlation analysis reveals positive associations between sustainability knowingness and sustainability attitudes, whereas sustainability behavior is positively related to both constructs but only in the social dimension. These results highlight the necessity of teaching sustainability looking for behavioral changes in the Degree of Primary Education.

Keywords: sustainability consciousness; sustainability knowingness; sustainability attitudes; sustainability behavior; higher education; primary education; pre-service primary teachers

1. Introduction

In the 2030 Agenda for Sustainable Development the United Nations proposed as a goal to improve sustainability education as a measure to take urgent action to combat climate change and its impacts. With this contribution the authors encourage the need to include sustainability (not only in the scientific content but also in behavioral and attitudinal aspects) in the official pre-service primary teachers' syllabus. First, a brief introduction is given about sustainability knowledge, attitudes and behavior and how they are related in their multiple dimensions. After that, reflect on why and how sustainability must be taught in higher education, based on a deep literature research and the paths and highlights of the United Nations. Finally, we address the degree of instruction in sustainability specifically in teachers in initial training, focusing on the necessity of pre-service primary teachers to accomplish environmental consciousness through sustainable development.

We have based our research on the Sustainability Consciousness Questionnaire (SCQ) [1] (Appendix A) with last year's students of the Degree in Primary Education (University of Extremadura, Spain). According to the authors of the SCQ test, the aim of this questionnaire is to estimate the sustainability consciousness, a construct defined by them as the experience or awareness regarding sustainability phenomena (which includes environmental, societal and economic perspectives). Sustainability consciousness is an operational concept that refers to experiences and perceptions associated with ourselves (such as

beliefs, feelings and actions) in the context of sustainable development. Thus, this is a psychological construct represented by the categories of knowingness (knowledge-based component that incorporates cognitive and affective aspects), attitudes and behavior. This aspect is fairly relevant for sustainability since, nowadays, the change in people's knowledge, attitudes and behavior is pointed out in the UNESCO framework as essential to accomplish sustainable development [2].

A huge methodological analysis description of SCQ is shown in this paper with the intention of facilitating for other researchers the reproduction of the present work with students of different educational levels. A discussion about sustainability consciousness in primary teachers in training is provided, including some suggestions for executing correctly and successfully inclusion of Higher Education for Sustainable Development (HESD). Those changes in initial training are required considering the extending of the sustainability consciousness of future teachers to their upcoming students and their future role qualifying them to make moral decisions in the uncertain future.

2. Objectives of Research

The aim of this study is to feature the sustainability consciousness (knowingness, attitudes and behavior) of a sample of Spanish pre-service primary teachers. Several specific research objectives are raised:

1. To describe the sustainability consciousness of participants, including their three constructs in the three dimensions of sustainable development (environmental, social and economic).
2. To analyze associations between constructs of sustainability consciousness.
3. To explore for evidence of gender bias in sustainability consciousness, as well as in the associations between its constructs.

3. Background

The background section starts by introducing sustainability as the integration of multiple different elements, which determine that a holistic approach is the suitable approximation to this field. Then, we expose that teaching sustainability in higher education requires to adopt European paths oriented towards meaningful learning acquisition. Active methodologies are proposed to reach that educational aim. The Primary Education Degree deserves special interest in our contribution, so a brief dissertation is provided to emphasize the necessity of sustainability education for teachers in initial training. Finally, and considering the three different dimensions of sustainable development analyzed through SCQ (economy, society and environment), an overview regarding topics related to sustainability knowingness, attitudes and behavior is made.

3.1. *Environmental Knowledge, Attitudes and Behavior: Pedagogies for Higher Education for Sustainable Development*

The Industrial Revolution transformed economic, social and technologically the world, increasing environmental consternation as response of nature damage. That required international policies and economical changes. Usually, the beginning of the sustainability concept is associated with the Brundtland Report (1987) [3] which is based in intragenerational justice (referring to the fact that all persons from different parts of the world should reach life satisfaction and meet their individual needs) and intergenerational justice (attempting to preserve nature for future generations) [4,5].

The appropriated approximation to the concerning situation of planetary emergency [6] should be done through classical philosophers as Kant (1724–1804) or scientists as Humboldt's (1769–1859) certainties: through an integrated view of nature (it is not only about climate or soils, the Earth system is more complex and a prodigious deal more interesting) [7,8]. The intrinsic characteristics of sustainability are the inevitable combinations of several phenomena and singularities which are interrelated and unified on Earth: all is connected [9–11]. In this section we present pedagogies for

teaching sustainability (social, economic and environmental aspects) through sustainable knowledge, attitudes and behavior.

The relationship between knowledge, attitudes and behavior has been studied previously and results differ between authors. For Jensen [12], who revisited the correlation between environmental knowledge and behavior, high levels of knowledge do not imply pro-environmental actions. He explained that the lack of correlation between knowledge and behavior is due to the kind of environmental education, and their orientation, which is implemented by a scientific approach only teaching isolated environmental problems. However, later, Zsóka et al. [13] reported strong correlations between the intensity of an environmental education and better environmental behaviors, which are independent of different factors (gender, age or previous habits). In the same line, Mobley et al. [14] found that reading environmental literature is a predictor of environmentally responsible behavior and an even stronger predictor to presenting environmental concern.

The lack of knowledge might limit environmental behavior [15], lifestyles choices and decisions affecting individuals who care about environmental problems and their causes [16]. Environmental education should be oriented towards developing the abilities of students to reach these behavioral changes. Kopnina and Cocis [17] propose an ecocentric value focus teaching, which promotes responsiveness of environmental difficulties and inspiring environmental sustainable behaviors, just as developing specific skills and competencies is required for building a circular economy.

Higher Education for Sustainable Development (HESD) has been encouraged by UNESCO through different programs [18] and currently with Agenda 2030 [19]. Higher education, universities and research institutions have a huge responsibility due to their important role in the training of responsible citizens and decision makers. In higher education sustainable practices and policies should be implemented to promote ecological attitudes, as well as to favor the acquisition of sustainable management models [20] with which to generate a green culture way of thinking and to perform alliances with other stakeholders, improving their role in society [21].

Individuals' ability to rapidly adapt to different situations is required for the appropriate transition to sustainable future societies (which are in constant development). In current teaching, the "action approach" is very common [12], a "competences" model in higher education has been implemented through the Bologna Process during the last decade [22–24]. It was developed with the aim of satisfying Europe's economic necessities: future employers need to cope with different professional problems. Some abilities (also known as "soft skills"), such as critical and system-thinking competence, development of ethical skills, interpersonal competences (communicative and collaborative), motivation, emotions or aptitudes, are also required.

Teaching and learning methods should be modified since the introduction of sustainability competences in the syllabus [25]. This methodological change is also encouraged by the Bologna Process, where the educator role begins as facilitator and should guide students through their own meaningful learning process [26]. Pedagogies recommended in the scientific literature for HESD are those that engage head (cognitive domain), hand (psychomotor domain) and heart (affective domain, including attitudes and behaviors) [27]. Fortunately, teachers' affective dimension is increasing in magnitude and currently there is no doubt of the importance of lecturers' affective domain [28].

Regardless of difficulties in Higher Education for Sustainable Development inclusion (syllabus structure, limited resources, teachers' resistance to change and their lack of scholarly expertise HESD [29]) it is easy to find examples of good practice [30–32]. A combination of the current practice ("learning by doing") with explicit reflection on what and how to learn from that practice ("learning by reflection") should be made by universities; this could be easily done using real-world issues [33]. Frank and Stanszus [34] suggest self-inquiry-based and self-experience-based learning for reorienting the consumption model of students and placing importance on emotional dimensions for sustainable consumption and obtaining behavioral changes after application of the methodology. Some sustainability transversal competences, such as autonomous learning, creativity or adaptation to new situations, are developed through project-based learning (PBL) [35]. PBL is also included in the summary offered by Tejedor et al. [36],

together with projected oriented learning, case of study, simulation and service learning as didactical proposals to promote competencies in sustainability. Implementation of these active methodologies in higher education is quite important for the potential benefits in terms of knowledge and sustainable competences acquisition. Zamora-Polo and Sánchez-Martín [37] suggested the sustainability view as the multi-integration of five dimensions: spiritual development, equity and global ethics, environmental awareness, development cooperation and global environmental policies. In this way, they displayed sustainability as an integral ecology. The authors also declared that universities must intentionally integrate that vision. Thus, new relationships that nature needs between humans and the environment (and all dimensions of sustainable development) could be established. Due to their holistic approach, sustainability must be taught using systems thinking [38], promoting the students' ability to see the interconnections between all their different dimensions and their complexity (of both natural and cultural processes). That would help students to process theoretical knowledge and to encourage attitudinal and behavioral changes. For a correct HESD implementation, lecturers ought to create intra- and inter-disciplinary scenarios where learners have the opportunity to recognize themselves as principal actors. Consequently, they can re-evaluate and realize their responsibility and the global planetary repercussion of their conduct [39].

3.2. Teaching Sustainability in Primary Teachers Degree

Education used to be referred to as a soft measure for achieving sustainability [40]. That is why efforts should be made in educating teachers for persisting and long-term behavioral and attitudinal changes to achieve a sustainable future. Several transversal competences related to sustainability were found after a general revision of the Primary Education Degree program of University of Extremadura, the sample of this research, including: (i) peace values promotion, (ii) ensuring a sustainable future through appropriate behavior and (iii) recognizing the influence between science, society and technological development [41].

Calero et al. [42] suggested that despite the efforts made and the different initiatives, future teacher education is quite far from being the correct one for promoting sustainable development. Some obstacles, such as low sustainability culture in teachers and traditional methodologies implementation, are identified. Cebrian and Junyent [43] also found that teachers in training almost do not contemplate elements which are considered critical for ESD (such as problem-solving of environmental issues, critical thinking or the sense of belonging to the environment). In contrast, pre-service primary teachers tend to prioritize the acquisition of knowledge to the detriment of other types of learning, such as the promotion of ethical values, positive attitudes towards sustainability and the management of affective aspects (emotions, attitudes, interests, and so on) among their future students. Considering these limitations, these authors encouraged the integration of sustainability in education (from initial training of pre-service primary teachers) as a priority in terms of the basic literacy of future citizens [32,42].

In the last two decades, educational research has revealed the emotional and behavioral transmission from teachers to students. In addition, these affective aspects are highly related to cognition, influencing learning [28,44]. This pattern has been also detected with teachers in initial training who, as nonscientific university students [45], experience negative emotions against scientific content related to sustainability [46]. Several studies have linked these negative emotional experiences in science lessons with teaching methods [47]. Considering this aversion, it is necessary to improve the affective domain of future teachers, since it would be a way to enhance the learning as well as the attitudes and behavior of their upcoming students [28,48]. Dávila-Acedo et al. showed that pre-service primary teachers could improve their affective aspects by implementing active learning methodologies [46]. Discussion and improvement of pedagogical methods of science teaching are required for teacher education [49]. In this contribution we offer evidence of the necessity of new practices in pre-service primary teachers' education in order to connect sustainability knowledge, attitudes and behavior. Methodological change is required if we want to revert and reexamine our global models into becoming sustainable ones.

3.3. Economic, Social and Environmental Issues in the Sustainability Conciousness Questionnaire

SCQ is a multifaceted instrument that presents sustainability as a complex field that requires a holistic approach (integrating three pillars: economic, environmental and social issues and contemplating knowledge, attitudes and behavior). Despite environmental, economic and social elements being interconnected, they have been traditionally treated separately: on the one hand, social, economic and anthropogenic problems like poverty, hunger, illiteracy or homelessness; and on the other hand, environmental glitches such as deforestation, acid rain, global warming or pollution [50]. A symmetrical relationship between sustainability elements is the aim of sustainable development. However, different models give priority to one or to another approach; and, in current policies, the economy dominates social and environmental aspects [51]. The SCQ, as implemented in this work, includes diverse declarations related to these three dimensions which are described further in this section.

Environmental problems, unfairness in economic growth and social inequalities [52] are analyzed in the SCQ. The human factor is presented as the main contribution to climate change, but not all humans make an impact at the same level [53]. The splitting up of the world into “Global North” and “Global South” in terms of politics and socio-economical dimensions is quite common [54,55]. This division is not only about prosperity or anthropological progress but it is also scientific [56]. Economic development demands profit expansions which leads to resources consumption (including water and fossil fuels) and waste production in all different stages of production processes [53]. This economic growth is surpassing ecological nature limits which harms human development and the wellness of present and future generations, and also has a negative impact on the lives of non-human beings [57].

To separate economy from environment is not possible in a sustainability context [37], their dimensions are intertwined. Basic human needs (essentials for a comfortable and decent life) are limited and defined, but human desires are infinite (in terms of both quantity or quality). Unless people decide that they do not need more than what they have, unconscionable economic growth will not stop [57]. In this sense, some spiritual readings invite us to reflect on living simple lives, modifying our social consuming pattern and moving on to a new one, within social and ecological limits [58]. The same lesson is shared by Good Living (or Sumak Kawsay), an indigenous cosmovision that proposes to get only what is needed for a decent life, while at the same taking care of nature, which we are part of [57,59–61]. These aspects are addressed in SCQ items, which provides factual and objective knowingness [1] related to the necessity of a fair distribution of goods and services among all people in the world while suggesting behavioral and attitudinal changes in terms of changing our lifestyles, respecting human rights and reducing resource consumption.

Reducing food waste and changing our eating habits (as behavioral changes that are indicated in the SCQ) are also critical pressures with heavy ecological impact, not only in terms of pollution, but also in biodiversity loss, water use and public health [62–65]. Earth’s resources are finite, so changing our pro-grow culture and reducing consumerism are not an option, but a duty [66–69]. Global North behaviors and attitudes are mainly responsible for the Earth’s future. It is an Anthropocene responsibility to conserve natural ecosystems, revaluing microorganisms’ role and healthy biota population in marine and terrestrial biomes to ensure healthy and safer environments [70], which are a human right [71]. We have to protect Earth and there is no teleological reason nor neoclassical utility theory, there are no species hierarchies [72] (p. 39). We must ensure ecosystems welfare not only for the present but for future generations [73], and to safeguard all life beings [74,75]. The SCQ analyzes all these issues. Our interest is focused on studying sustainability knowledge, attitudes and behavior related to all these topics in a sample of Spanish pre-service primary teachers.

4. Materials and Methods

4.1. Sample

The sample consists of 151 pre-service primary teachers (76.2% female, average age 22.26), all being students enrolled in a Science Education subject (namely Knowledge of the Natural Environment in

Primary Education) of the seventh semester of the Degree in Primary Education (eight semesters in all, University of Extremadura, Spain) which are divided into three different groups. Regarding the previous studies of these students in secondary education, 67.5% of participants studied a modality of humanities, social sciences or arts in upper-secondary education, whereas 32.5% of them attended a science, health sciences or technology itinerary at this educational level.

This sample was intentionally chosen, not randomly, from the population of primary teachers in training at the University of Extremadura who voluntarily answered a questionnaire about sustainability consciousness. Therefore, results of this contribution may not be extrapolated beyond the local context they represent: a diverse sample of Spanish pre-service primary teachers. All data were collected at the Faculty of Education, on three different days in December 2019, each day with a different group. Prior to participation, students were informed about the goals of the research, duration, procedure and anonymity of their data. Participation was voluntarily and it was possible to withdraw participation at any time. All participants provided verbal informed consent prior to data collection. During the administration of the questionnaire (an online test answered using phones, tablets and computers), a researcher was always present.

4.2. Instrument: The Sustainability Consciousness Questionnaire

The instrument used in this research was a translation of the short version of the SCQ (Appendix B), a test designed and validated, with a sample of 638 Swedish secondary education students (grade 12, ages 18–19), by Gericke et al. [1] (Appendix A). The SCQ consist of 27 Likert-scale items with which to measure knowingness, attitudes and behavior with regard to sustainable development (covering their three dimensions: environmental, social and economic) [1]. Thus, the SCQ is structured in three sections: sustainability knowingness (K1–K9 items), sustainability attitudes (A1–A9 items) and sustainability behavior (B1–B9 items) (Table 1). These sections cover what people acknowledge as the necessary features of sustainable development, attitudes towards the sustainable development issues and what people do in relation to the sustainable development issues under consideration. Items of each section are, in turn, related to the three dimensions of sustainable development (environment, society and economy) (Table 1), allowing to measure knowingness, attitudes and behavior within each dimension. In this sense, the SCQ may be also structured into nine subsections (Figure 1).

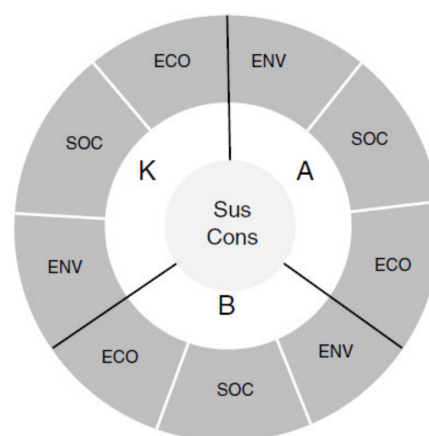


Figure 1. Three sections (sustainability knowingness, K; sustainability attitudes, A; and sustainability behavior, B) and nine subsections (within the dimensions of environment, ENV; society, SOC; and economy, ECO) of sustainability consciousness according to the SCQ items. Source: Gericke et al. [1].

The SCQ items are formulated considering the UNESCO framework as a theoretical foundation and they cover the full spectra of the 15 subthemes of sustainable development defined by UNESCO [2], except rural development. These items are presented mixed to participants who answer them using a Likert scale ranging from 1 “strongly disagree” to 5 “strongly agree”.

Table 1. Descriptive statistics (mean and standard deviation) and properties (factor weight) for 27 items and 9 factors of the Sustainability Consciousness Questionnaire (SCQ) with pre-service primary teachers. Item including an “i” are inverted. Reliability (Cronbach’s α) of each construct of sustainability consciousness (knowledge, attitude and behavior) is also included.

Sustainability Consciousness			Factor Weight	Mean	SD
Sustainability Knowingness ($\alpha = 0.766$)					
Env.	K1	Reducing water consumption is necessary for sustainable development	0.412	4.34	1.03
	K2	Preserving the variety of living creatures is necessary for sustainable development (preserving biological diversity)	0.550	4.64	0.67
	K3	For sustainable development, people need to be educated in how to protect themselves against natural disasters	0.350	4.26	0.98
Soc.	K4	A culture where conflicts are resolved peacefully through discussion is necessary for sustainable development	0.574	4.29	0.97
	K5	Respecting human rights is necessary for sustainable development	0.614	4.79	0.51
	K6	To achieve sustainable development, all the people in the world must have access to good education	0.693	4.72	0.51
Eco.	K7	Sustainable development requires that companies act responsibly towards their employees, customers and suppliers	0.584	4.57	0.72
	K8	Sustainable development requires a fair distribution of goods and services among people in the world	0.697	4.52	0.79
	K9	Wiping out poverty in the world is necessary for sustainable development	0.501	3.87	1.09
Sustainability Attitude ($\alpha = 0.710$)					
Env.	A1i	I think that using more natural resources than we need does not threaten the health and well-being of people in the future	0.420	4.46	0.98
	A2	I think that we need stricter laws and regulations to protect the environment	0.728	4.68	0.59
	A3	I think that it is important to take measures against problems which have to do with climate change	0.347	4.93	0.29
Soc.	A4	I think that everyone ought to be given the opportunity to acquire the knowledge, values and skills that are necessary to live sustainably	0.848	4.85	0.41
	A5	I think that we who are living now should make sure that people in the future enjoy the same quality of life as we do today	0.357	4.74	0.55
	A6	I think that women and men throughout the world must be given the same opportunities for education and employment	0.372	4.9	0.46
Eco.	A7	I think that companies have a responsibility to reduce the use of packaging and disposable articles	0.402	4.76	0.65
	A8	I think it is important to reduce poverty	0.714	4.81	0.57
	A9	I think that companies in rich countries should give employees in poor nations the same conditions as in rich countries	0.715	4.54	0.83
Sustainability Behavior ($\alpha = 0.628$)					
Env.	B1	I recycle as much as I can	0.695	3.57	1.24
	B2	I always separate food waste before putting out the rubbish when I have the chance	0.389	3.92	1.26
	B3	I have changed my personal lifestyle in order to reduce waste (e.g., throwing away less food or not wasting materials)	0.260	4.15	1.06
Soc.	B4	When I use a computer or mobile to chat, to text, to play games and so on, I always treat others as respectfully as I would in real life	0.469	4.8	0.49
	B5	I support an aid organization or environmental group	0.518	2.19	1.36
	B6	I show the same respect to men and women, boys and girls	0.347	4.95	0.28
Eco.	B7	I do things which help poor people	0.474	3.48	0.98
	B8	I often purchase second-hand goods over the internet or in a shop	0.297	2.66	1.45
	B9	I avoid buying goods from companies with a bad reputation for looking after their employees and the environment	0.362	2.9	1.24

4.3. Statistical Analysis

Data were analyzed using parametric statistical tests since they fitted a normal distribution. Normality tests (Kolmogorov–Smirnov), tests used to compare groups (Student’s *t*-test), correlation analysis (Pearson’s correlation) and factor analysis were performed with the software SPSS version 25 (IBM software, New York, NY, U.S.A.). For the extraction of the factors, principal axis factoring and Oblimin rotation were used [1]. Once calculated, factors were stored as centered variables. Sample adequacy and reliability of factorial models were assessed using Kaiser-Meyer-Olkin and Cronbach’s alpha. Graphic representation (box plots, violin plots and statistical network analysis) was created using the open-source graphical program for statistical analysis JASP version 0.12.1 (University of Amsterdam, The Netherlands).

Box plots and violin plots are used to represent gender differences, whereas networks represent main interactions between analyzed variables. The statistical network analysis (through generalized method of moments, GMM estimator) is used to obtain a systemic perspective of the interactions of the different constructs. In the network, variables are represented as knots and their interactions as edges. Two variables are connected in the network if, in addition to correlation, there is some covariance between those two variables that cannot be explained by another variable.

5. Results

5.1. Factorial Analysis of SCQ with Pre-Service Primary Teachers

Factorial analysis results showed that items of SCQ, translated to Spanish and answered by a sample of pre-service primary teachers, could be modelled into three latent factors corresponding to the sustainability knowingness (grouping K1–K9 items), sustainability attitudes (grouping A1–A9 items) and sustainability behavior (grouping B1–B9 items) of these students. This factorial model is considered adequate since the sample adequacy measure (KMO test) was 0.776 and the percentage of variance explained was greater than 50% (namely, 59%). Moreover, these three constructs were reliable according to Cronbach's α which was always greater than 0.6 (Table 1), being greater than 0.7 in the case of sustainability knowingness and sustainability attitudes.

Each of these three factors are composed of three second-order factors relating to one of the three pillars of sustainable development (environmental, social or economic dimensions). Then, nine factors can be extracted: sustainability environmental knowingness (grouping K1–K3 items), sustainability social knowingness (grouping K4–K6 items), sustainability economic knowingness (grouping K7–K9 items), sustainability environmental attitudes (grouping A1–A3 items), sustainability social attitudes (grouping A4–A6 items), sustainability economic attitudes (grouping A7–A9 items), sustainability environmental behavior (grouping B1–B3 items), sustainability social behavior (grouping B4–B6 items) and sustainability economic behavior (grouping B7–B9 items). The factor loadings corresponding to items of each of these nine factors are included in Table 1. These results supported the internal validity of the translation of SCQ. On the other hand, the same factorial structure (three first-order factors and nine second-order factors) was observed in the validation of the original SCQ, which supports the external validity [1]. Altogether, these observations support that the translation of SCQ is suitable for estimating the different dimensions of sustainability consciousness of Spanish primary teachers in training.

5.2. Sustainability Consciousness of Pre-Service Primary Teachers: Descriptive Statistics of SCQ Items and Gender Analysis

Analysis of SCQ items revealed that pre-service primary teachers assigned higher scores to items related to sustainability attitudes (mean of 4.74, mean of items between 4.46 and 4.93) and sustainability knowingness (mean of 4.44, mean of items between 3.87 and 4.79), whereas they hold lower levels in sustainability behavior (mean of 3.62, mean of items between 2.19 and 4.95) (Table 1).

The dimension to which pre-service primary teachers assigned the highest scores, within the three analyzed areas (sustainability knowledge, sustainability attitudes and sustainability behavior), was the social dimension (means of 4.83 in items corresponding to sustainability social attitudes, 4.60 in items of sustainability social knowingness and 3.98 in items of sustainability social behavior) (Figure 2). Following this dimension, they attributed similar values to environmental and economic dimensions, but only in sustainability attitudes and sustainability knowingness (Figure 2). Regarding sustainability behavior, participants assigned higher levels to the environmental dimension (mean of 3.89) compared to the economic dimension (mean of 3.01).



Figure 2. Mean of the items of the different dimensions (environmental, social and economic) of sustainability consciousness constructs (knowledge, attitude and behavior) in pre-service primary teachers.

Regarding gender analysis, male pre-service primary teachers assigned higher scores to several items of sustainability economic behavior (Figure 3). Specifically, items B8 and B9 (relating to buying second-hand goods or goods from companies with a bad reputation regarding their workers or the environment) were higher in male participants. Student's *t*-test for two independent samples was performed at a 95% confidence level. Results showed that there were significant differences ($p < 0.05$) between the means of males and females for these both items. There is no gender bias in the rest of the SCQ items.

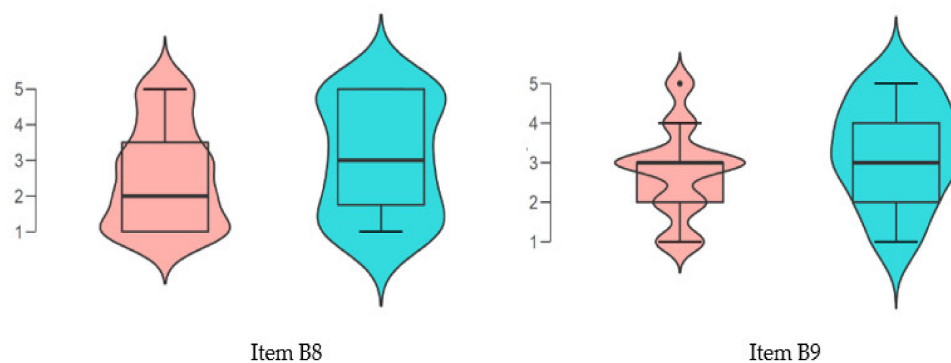


Figure 3. Gender differences in sustainability economic behavior (items B8 and B9) between male (blue) and female (orange) pre-service primary teachers. The figure includes the box plot (central bold line represents median value whereas box size represents 25th and 75th percentiles) and the violin plot (showing the density of the data at different values).

5.3. Associations Between Constructs of Sustainability Consciousness in Pre-Service Primary Teachers

Correlation analysis revealed that sustainability knowingness and sustainability attitudes were associated positively in primary teachers in training, with these correlations being detected between the three analyzed dimensions of sustainable development (environmental, social or economic) (Table 2, Pearson's correlation, p -value < 0.01). These results suggest that those pre-service primary teachers who hold a higher level of sustainability knowingness (regardless of environmental, social or economic dimension) are those who have more positive attitudes towards sustainable development (irrespective of these three analyzed areas). This positive association between sustainability knowingness and sustainability attitudes of pre-service teachers is reflected in the positive correlation between their corresponding first-order factors (Pearson's correlation coefficient of 0.733, p -value < 0.001).

Table 2. Pearson’s correlations coefficients between factors related to constructs of sustainability consciousness of pre-service primary teachers (knowingness, attitude and behavior) in their different dimensions (environmental, social and economic). Bold highlights significant correlations (** p -value < 0.01; * p -value < 0.05).

		Sustainability Knowingness			Sustainability Attitude			Sustainability Behavior		
		Env.	Social	Economic	Env.	Social	Economic	Env.	Social	Economic
Sustain. Knowing.	Env.	1	0.470 **	0.555 **	0.576 **	0.398 **	0.366 **	0.056	0.162 *	0.150
	Social		1	0.554 **	0.525 **	0.566 **	0.350 **	0.108	0.178 *	0.121
	Economic			1	0.574 **	0.432 **	0.597 **	0.043	0.180 *	0.092
Sustain. Attitude	Env.				1	0.509 **	0.425 **	0.071	0.197 *	0.002
	Social					1	0.261 **	0.099	0.209 **	−0.017
	Economic						1	−0.125	0.250 **	−0.003
Sustain. Behavior	Env.							1	0.047	0.344 **
	Social								1	−0.064
	Economic									1

Regarding sustainability behavior, results revealed interactions of this construct with sustainability knowingness and sustainability attitudes, but only for the sustainability social behavior. Thus, correlation analysis showed that the sustainability social behavior of pre-service primary teachers was associated positively with their sustainability knowingness and sustainability attitudes (in both cases these positive correlations were detected for environmental, social and economic dimensions) (Table 2, Pearson’s correlation, p -value < 0.05). Such correlation coefficients were stronger and of a greater significance for the interactions with sustainability attitudes. These interactions suggest that those pre-service primary teachers who hold more knowingness and, specifically, better attitudes towards sustainable development (regardless of environmental, social or economic dimension) were those who manifested a more sustainable behavior, but only in the social dimension. There are no significant interactions for sustainable environmental behavior and sustainable economic behavior reported by participants, beyond the positive interaction between themselves (Table 2).

The interactions between the nine second-order factors describing the sustainability consciousness of pre-service primary teachers are represented in the network of Figure 4. This network displays that the different dimensions (environmental, social or economic) of sustainability knowledge, sustainability attitudes and sustainability behavior of these students are related, as shown in Pearson’s correlations coefficients of Table 2. The only exception to this general pattern is the sustainability social behavior, which is not related to the other two dimensions of sustainability behavior (Table 2). Furthermore, this network represents the associations between sustainability knowingness and sustainability attitudes of pre-service primary teachers, showing that the stronger interactions between these constructs are established for the same dimension (environmental, social or economic) (as shown in Pearson correlations coefficients of Table 2). Additionally, the network evinces the association of sustainability social behavior of teachers in initial training with the different dimensions (environmental, social or economic) of sustainability attitudes.

5.4. Evidence of Gender Bias in the Associations between Constructs of Sustainability Consciousness in Pre-Service Primary Teachers

Gender analysis of correlations revealed that positive associations between sustainability knowingness and sustainability attitudes occurred in both male and female pre-service primary teachers. These interactions were detected in both genders for the different dimensions (environmental, social or economic), although the majority of the correlations for sustainability economic attitudes were only detected in female participants (Table 3). Regarding interactions for sustainability behavior, positive associations of sustainability social behavior with sustainability knowingness and sustainability attitudes were only detected in female pre-service primary teachers (Table 3). These correlation coefficients were different from male ones (bootstrapping, $N = 1000$, confidence interval of 95%). Female pre-service teachers with higher levels of sustainability knowingness and sustainability attitudes were those

6. Discussion and Implications for Initial Training of Primary Teachers

In this section, the authors compare their results with previous studies in accordance with the objectives initially set. In this contribution the authors offered an adapted Spanish version of the SCQ, originally designed by Gericke et al. [1]. A careful treatment of the test provision and a final interpretation were done to ensure equivalent metrical properties of our instrument [76]. In order to attain a Spanish translation of the SCQ, the authors followed the same structure that original authors offered [1]. Internal reliability and construct validity were proved through statistical and factorial analyses. Our results suggest that the SCQ can be used in other samples, not only with secondary education students (as in the original article of Gericke et al. [1]), but also with higher education students (as in the present research). This converts the SCQ into an all-rounder questionnaire with multiple applications. Despite the different samples, some similarities were found with the original version of the SCQ: our participants also reported the highest consciousness level in sustainability attitudes (highlighting social issues). In addition, sustainability behavior also got the lowest average, emphasizing economical dimension with the poorest results [1].

Results of the present contribution revealed that the sample of Spanish pre-service primary teachers hold high levels of sustainability attitudes (in the three dimensions of sustainable development, but above all towards social aspects). Determining the sustainability attitude is important since intentionality is considered a determinant which sets in motion real behavior [77]. Our results agree with a previous work in which the SCQ is used, which it was carried out by Olsson et al. [78] with elementary and high school students: gender effects are also reported in some sustainability behavior items and students also assigned the highest mean values to sustainability attitude items.

Our results are also in line with those of other studies with teachers in training showing that pre-service teachers' attitudes towards sustainable environmental education seem to be positive and moderately high [79,80]. Participants also assign high scores to items of sustainability knowingness (similarly, in the three analyzed dimensions), to an extent that differs from previous observations revealing that pre-service teachers are not aware of the impact of daily activities on the environment [81]. Zamora-Polo et al. [82] recently published a study about the knowledge that university students have about sustainability development goals (SDGs), by comparing between Health, Education and Engineering students. Results show a low degree of knowledge of the SDGs in all of them, but find that pre-service teachers are more professionally involved with the SDGs than the rest.

Regarding sustainability behavior, participants report a low level (highlighting the economic dimension), a situation which is in contrast with prior studies, which have shown a medium level of this construct in teachers in training [83]. As a difference from the original article, we analyzed gender differences. There is no gender bias in items of the SCQ, except for several items of sustainability economic behavior which were higher in the male subset. This gender bias differs from the majority of previous research works about the effect of gender in sustainability consciousness with students of different educational levels, according to which girls hold higher levels of sustainability consciousness [80,84,85]. Nevertheless, some studies also reflected on this unanticipated gender bias, and found that male participants tend to have a more sustainable mindset than female participants [77]. Other studies suggested higher sustainable consciousness among female participants, and this trend has also been observed with samples of pre-service teachers [86,87]. Likewise, focusing on sustainability behavior, results of this work also disagree with previous findings showing that sustainability economic behavior (related to consumption habits) do not vary significantly by gender in pre-service teachers [83].

Correlation analysis between constructs of sustainability consciousness evinces positive interactions between sustainability knowingness and sustainability attitudes (observed in the three dimensions of sustainable development). These associations agree with prior studies that support that pre-service teachers who possess a satisfactory level of environmental knowledge are those with a tendency to hold favorable attitudes to the environment [86]. However, there are other works that did not find an association between knowledge and attitudes towards sustainable development in teachers in training [88]. With regard to sustainability behavior, in general, it is not associated with

sustainability knowledge and attitudes [89]; however, there are some positive interactions with both these constructs for the social dimension due to the female subset. The general lack of relation between sustainability behavior and the other two constructs of sustainability consciousness contrast previous findings showing that knowledge and attitudes contribute to pro-environmental behaviors among pre-service teachers [90]; this observation is aligned with results for female pre-service teachers (but for the social behavior, not in environmental dimension).

In sum, correlation results suggest that pre-service primary teachers with a high sustainability knowingness are those who report higher sustainability attitudes, but not necessarily those who manifest a better sustainability behavior. This difficulty regarding changing behavior has been previously described. According to current educational research, behavior regarding sustainable development is difficult to improve, even after specific educational interventions [91]. To modify these behavioral aspects it is first necessary to change beliefs related to sustainability [92], but raising awareness and changing attitudes towards sustainable development is not enough to change behavior [77,93]. Behaviors are too complex and contextual (with a range of variables affecting them) that behavioral change is difficult to materialize [92,93], even when holding higher levels of knowingness and attitudes as occurs with the sample of pre-service teachers of this contribution. Neither is higher ecological knowledge enough to increase eco-friendly mindsets, unless it is very strongly related to global concerns. In this sense, a study with university students from different majors reveals that educational science students had the weakest ecological knowledge, indicating the significant need for science educators to improve sustainability knowingness [94].

The results of this research could have some implications in the initial training of pre-service primary teachers. An analysis of sustainability activities in Spanish primary education books [95] reveals that most of them (63–90%) are cognitively simple activities, which does not force students to evaluate or engage in depth in cognitive processes. Current educators and pre-service primary teachers should be trained to fill that gap, having knowledge of other resources. In this way, they could offer an accurate holistic concept of sustainability since books do not offer that vision. Thus, the results encourage improvement in the teaching of sustainability in pre-service teacher education programs [92,96,97], especially in those aspects concerning methodologies and students' behaviors.

Pre-service programmed covered a wide range of interrelated issues and dimensions of sustainable development but the results of this work support that they are not sufficiently covered in a balanced manner [98]. In this sense, it is necessary to develop means of facilitating students' pro-sustainability behaviors [99], providing meaningful experiences related to these aspects [91]. This improvement is required especially if we consider that the sustainability consciousness of these students is not different from other undergraduate students [100], and that they can transfer this consciousness in their future teaching action [101]. These educational deficiencies are recognized by pre-service teachers, who think that their preparation as teachers should include more aspects about sustainability and how to teach it in their future teaching action [102]. In addition, the inclusion of these activities related to education for sustainability is well-valued by these students [103].

The methodology that teachers implement in science lessons is situated as one of the main agents to generate changes in attitudes and behaviors of teachers in training [104]. Holistic and pluralistic approaches to teaching sustainability have been shown to be potentially effective in terms of sustainability consciousness in students [105]. A previous study conducted with 120 teachers in initial training concluded that teaching method is the main cause of their affective responses related to scientific contents and their learning: they prefer to learn science through "hands-on activities" or "gamification" instead of "pure oral exposition" and other traditional methodologies [47]. Educational interventions to address constructs of sustainability consciousness in initial teacher training may be based on some methodologies and approaches supported as motivating by previous studies, such as: nature field trips [91], project-oriented learning [106], inquiry-based learning [107], hands-on learning experiences [108], green chemistry experiments [109], interdisciplinary approaches relating several subjects [92,110,111], argumentation [112], electronic portfolios [113,114], blended learning [108],

extra-curricular activities [115], university-school partnerships [116], case method [77], and so on. These methodologies could be a vehicle to increase reflection and develop competencies in sustainability, contributing to enhancing the sustainability consciousness of these students. Another potential methodology that may be used to reach these purposes is service-learning (S-L) [117,118]. Our research group is working on the inclusion of S-L in higher education [117] and we encourage the utilization of the S-L methodology for HESD in teacher-in-training programs based on their multiple benefits. S-L promotes and involves students in direct experiences with nature and resolving complex problems, which has been discovered as crucial for the successful implementation of education projects for sustainability [119]. S-L helps to combine disciplinary academic components and action experiences, improving critical thinking and creativity [120], fitting perfectly with the spirit that sustainability requires. S-L promotes student cooperation in their local context, awakening awareness to protect their study areas, through an experiential learning process [121,122]. S-L encourages intra- and interdisciplinary work, permitting the development of transversal ethics competences, establishing emotional connection with the environment and with their classmates [117]. Overall, S-L has an unimaginable transformational capability, promoting the essence of sustainability by increasing students' knowledge (in terms of conceptual content), their abilities and competences by the time they get to solve social issues.

7. Limitations and Future Research

Regarding limitations, due to the fact that we have analyzed sustainability consciousness with a non-probabilistic sample of pre-service primary teachers (belonging to a specific university in one Spanish region), our conclusions may not be extrapolated to other contexts. It would be interesting to increase the sample, including a larger number of pre-service teachers of several Spanish universities, in order to establish stronger conclusions.

In terms of statistical analysis, 0.7 is considered as a sufficient measure of internal consistency (Cronbach's α) of the questionnaire [123] but we got a lower level for sustainability behavior (Cronbach's α of 0.628). This value is acceptable according to other educational studies assessing affective aspects in educational contexts [124]. Future studies with a larger sample could help us to clarify this aspect, contributing to improving the reliability of this construct. Another aspect to consider is the possible ceiling effect when participants answer attitude items, as shown in previous works [125]. Future research is needed to clarify this possibility.

Furthermore, it might also be interesting to conduct a longitudinal study with pre-service primary teachers, starting in the first year of University, to analyze how sustainability consciousness changes with the different subjects they study in their training. This study should also include qualitative research, in order to explore the causes of potential changes. On the other hand, we also suggest analyzing the impact of educational interventions based on the methodologies presented in this paper (particularly S-L) in the sustainability consciousness of pre-service primary teachers.

In addition, we think that it would be interesting to apply the Spanish version of SCQ in other universities, degrees and educational levels for comparison purposes. Namely, the authors are currently using this instrument with secondary education students of several Spanish regions.

8. Conclusions

Research work about the sustainability consciousness of a sample of pre-service primary teachers in Spain is presented in this paper. The results support that the sustainability consciousness of these students may be estimated using the Spanish translation of the SCQ, allowing researchers to establish the level of sustainability knowledge, sustainability attitudes and sustainability behavior of these students in relation to the different pillars (environmental, social and economic) of sustainable development. A description of the sustainability consciousness of participants was provided, showing that they assign higher scores to items of sustainability knowingness and sustainability attitudes above all in the social dimension. Regarding sustainability behavior, male pre-service teachers report higher

levels in items of the economic dimension that their female classmates. Correlation analysis reveals positive associations between sustainability knowingness and sustainability attitudes, regardless of the environmental, social or economic dimension, whereas sustainability behavior is positively related to both constructs but only in the social dimension. This association of sustainability social behavior with sustainability knowingness and sustainability attitudes results from the female future teacher subset. The results suggest that pre-service teachers, despite having high levels of sustainability attitudes, do not report high levels of sustainability behavior. This highlights the need to teach about sustainability in the initial training of teachers to improve not only knowledge learning but also modify their behavior, which could influence their future teaching of sustainability.

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Appendix A

Table A1. Sustainability Consciousness Questionnaire (SCQ)—original version.

			1	2	3	4	5
Sustainability Knowingness							
Environmental	K1	Reducing water consumption is necessary for sustainable development					
	K2	Preserving the variety of living creatures is necessary for sustainable development (preserving biological diversity)					
	K3	For sustainable development, people need to be educated in how to protect themselves against natural disasters					
Social	K4	A culture where conflicts are resolved peacefully through discussion is necessary for sustainable development					
	K5	Respecting human rights is necessary for sustainable development					
	K6	To achieve sustainable development, all the people in the world must have access to good education					
Economic	K7	Sustainable development requires that companies act responsibly towards their employees, customers and suppliers					
	K8	Sustainable development requires a fair distribution of goods and services among people in the world					
	K9	Wiping out poverty in the world is necessary for sustainable development					
Sustainability Attitudes							
Environmental	A1i	I think that using more natural resources than we need does not threaten the health and well-being of people in the future					
	A2	I think that we need stricter laws and regulations to protect the environment					
	A3	I think that it is important to take measures against problems which have to do with climate change					
Social	A4	I think that everyone ought to be given the opportunity to acquire the knowledge, values and skills that are necessary to live sustainably					
	A5	I think that we who are living now should make sure that people in the future enjoy the same quality of life as we do today					
	A6	I think that women and men throughout the world must be given the same opportunities for education and employment					
Economic	A7	I think that companies have a responsibility to reduce the use of packaging and disposable articles					
	A8	I think it is important to reduce poverty					
	A9	I think that companies in rich countries should give employees in poor nations the same conditions as in rich countries					

Table A1. Cont.

		1	2	3	4	5
Sustainability Behavior						
Environmental	B1	<i>I recycle as much as I can</i>				
	B2	<i>I always separate food waste before putting out the rubbish when I have the chance</i>				
	B3	<i>I have changed my personal lifestyle in order to reduce waste (e.g., throwing away less food or not wasting materials)</i>				
Social	B4	<i>When I use a computer or mobile to chat, to text, to play games and so on, I always treat others as respectfully as I would in real life</i>				
	B5	<i>I support an aid organization or environmental group</i>				
	B6	<i>I show the same respect to men and women, boys and girls</i>				
Economic	B7	<i>I do things which help poor people</i>				
	B8	<i>I often purchase second-hand goods over the internet or in a shop</i>				
	B9	<i>I avoid buying goods from companies with a bad reputation for looking after their employees and the environment</i>				

Appendix B

Table A2. Validated Spanish version of the Sustainability Consciousness Questionnaire (SCQ) used in this research. Likert scale ranging from 1 “absolutely disagree” to 5 “strongly agree”.

		1	2	3	4	5
Conocimiento						
Ambiental	K1	<i>Reducir el consumo de agua es necesario para el desarrollo sostenible</i>				
	K2	<i>Preservar la diversidad de seres vivos es necesario para el desarrollo sostenible</i>				
	K3	<i>Para lograr el desarrollo sostenible, la población debe ser educada acerca de cómo protegerse de los desastres naturales</i>				
Social	K4	<i>Para lograr el desarrollo sostenible, es necesaria una cultura en la que los conflictos se resuelvan de manera pacífica mediante el diálogo</i>				
	K5	<i>Para lograr el desarrollo sostenible, es necesario el respeto a los derechos humanos</i>				
	K6	<i>Para alcanzar el desarrollo sostenible, toda la población mundial debería tener acceso a una buena educación</i>				
Económico	K7	<i>El desarrollo sostenible precisa que las empresas actúen de manera responsable hacia sus empleados y clientes</i>				
	K8	<i>Para lograr el desarrollo sostenible es necesaria una distribución justa de los productos y los servicios entre la población mundial</i>				
	K9	<i>Para alcanzar el desarrollo sostenible, es necesario erradicar la pobreza en el mundo</i>				
Actitudes						
Ambiental	A1i	<i>Creo que usar más recursos naturales de los que se necesitamos no supone una amenaza para el bienestar y la salud de las generaciones futuras</i>				
	A2	<i>Creo que se necesitan leyes y regulaciones más estrictas para proteger el medio ambiente</i>				
	A3	<i>Creo que es importante tomar medidas contra los problemas relacionados con el cambio climático</i>				
Social	A4	<i>Creo que todas las personas deberían tener la oportunidad de adquirir conocimientos, habilidades y valores necesarios para vivir de manera sostenible</i>				
	A5	<i>Creo que quienes vivimos en la actualidad deberíamos asegurarnos de que las generaciones futuras puedan disfrutar de una calidad de vida similar a la que disfrutamos en la actualidad</i>				
	A6	<i>Creo que mujeres y hombres deben tener, en todo el planeta, las mismas oportunidades en educación y empleo</i>				
Económico	A7	<i>Creo que las empresas tienen la responsabilidad de reducir el uso de envases y productos no reutilizables</i>				
	A8	<i>Creo que es importante reducir la pobreza</i>				
	A9	<i>Creo que las empresas de los países ricos deberían generar empleos en los países pobres con las mismas condiciones que en países ricos</i>				
Comportamiento						
Ambiental	B1	<i>Reciclo todo lo que puedo</i>				
	B2	<i>Siempre que puedo separo los residuos, como los plásticos o los restos de comida, antes de tirarlos a la basura</i>				
	B3	<i>Tengo que cambiar mi estilo de vida para generar menos basura (por ejemplo, tirar menos comida o no derrochar determinados productos)</i>				
Social	B4	<i>Cuando uso mi teléfono móvil o mi ordenador para chatear con alguien siempre trato de respetar a los demás como lo haría en la vida real</i>				
	B5	<i>Apoyo a alguna ONG u organización medioambiental</i>				
	B6	<i>Siempre muestro el mismo respeto por mujeres y hombres</i>				
Económico	B7	<i>Hago cosas con las que ayudar a gente pobre</i>				
	B8	<i>En ocasiones compro artículos de segunda mano en lugar de comprarlos en una tienda o en internet</i>				
	B9	<i>Evito comprar artículos de empresas que tienen mala reputación respecto al cuidado del medioambiente o con sus empleados</i>				

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