

Article

Are Future Teachers Involved in Contributing to and Promoting the Reduction of Massive Waste Generation?

María Ángeles García-Fortes ¹, Unai Ortega-Lasuen ², Patricia Esteve-Guirao ¹, Oihana Barrutia ², Ana Ruiz-Navarro ¹, Daniel Zuazagoitia ², Magdalena Valverde-Pérez ¹, José Ramón Díez ² and Isabel Banos-González ^{1,*}

¹ Departamento de Didáctica de las Ciencias Experimentales, Facultad de Educación, Universidad de Murcia, 30100 Murcia, Spain; mariaangeles.garciaf@um.es (M.Á.G.-F.); p.esteve@um.es (P.E.-G.); anaruiz@um.es (A.R.-N.);.mvp@um.es (M.V.-P.)

² Departamento de Didáctica de la Matemática, Ciencias Experimentales y Sociales, Facultad de Educación, Bilboko Hezkuntza Fakultatea, Universidad del País Vasco/Euskal Herriko Unibertsitatea, 48940 Leioa, Bilbao, Spain; unai.ortega@ehu.eus (U.O.-L.); oihana.barrutia@ehu.eus (O.B.); daniel.zuazagoitia@ehu.eus (D.Z.); joseamon.diez@ehu.eus (J.R.D.)

* Correspondence: ibbg1@um.es

Abstract: Massive waste generation linked to overconsumption is considered one of the most significant socio-ecological issues today, becoming a challenge for health and well-being and a barrier to achieving sustainability. Education is key to raising awareness and involving citizens in the adoption of responsible consumption habits, facilitating the recognition of the relationship between our daily activities and the production of waste. The aim of this exploratory study is to analyse the perceptions and commitments of future secondary school teachers (FTs) toward this issue and to explore the educational approaches they propose to address it in the classroom (n = 138). In this work, a mixed-methods approach was used based on quantitative and qualitative data collected through a questionnaire. The results show that FTs have difficulties in recognising the different factors involved in the problem of massive waste generation. However, they incorporate the health and ecological vision, which is close to the holistic vision of the One Health approach. The majority of them take personal responsibility for the problem, although they opt for low-effort options. Regarding the educational proposals they design, only a minority can do it following a commitment-oriented approach.

Keywords: pre-service secondary school teachers; commitments; perceptions; One Health; teaching strategies; waste



Citation: García-Fortes, M.Á.; Ortega-Lasuen, U.; Esteve-Guirao, P.; Barrutia, O.; Ruiz-Navarro, A.; Zuazagoitia, D.; Valverde-Pérez, M.; Díez, J.R.; Banos-González, I. Are Future Teachers Involved in Contributing to and Promoting the Reduction of Massive Waste Generation? *Sustainability* **2024**, *16*, 7624. <https://doi.org/10.3390/su16177624>

Academic Editors: José Manuel Pérez Martín and Tamara Esquivel-Martín

Received: 4 August 2024

Revised: 29 August 2024

Accepted: 1 September 2024

Published: 3 September 2024



Copyright: © 2024 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 (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Massive waste generation and its arrival into natural systems is one of the most important socio-ecological problems today [1]. The accumulation of municipal solid waste (MSW) in the natural environment has a great environmental, social, economic and health impact. This waste, among other effects, pollutes the soil, air, surface continental water, groundwater and the sea, causing health problems, social inequalities, land occupation, destruction of the landscape, and the proliferation of pests or diseases. This underlines the fragile balance between ecological, animal and human health [2–6].

The average global amount of MSW produced is around 1 kg/day per capita and can reach 4.5 kg/day in countries with higher economic incomes [7]. According to these authors, by 2050, these figures could triple, reaching a global MSW production of 3.4 billion tonnes per year. There are also shortcomings in the management of this waste, either because practices and technologies are not 100% efficient or because they are not considered cost-effective for certain materials and, therefore, are not implemented [8]. In addition, these management methods are not free of negative consequences, which can lead to the production of leachate in landfills, the emission of greenhouse gases or the release of dioxins

and furans in incinerators and bottom ash in incinerators, which involve negative effects for environmental and human health [7,9].

Therefore, besides improving management methods, it is essential to rethink our society's consumption pattern as responsible for the massive generation of MSW [10]. Reducing consumption and waste generation is considered a crucial issue [11,12]. However, it is difficult for citizens to establish adequate links between the current socio-ecological crisis, consumption patterns and waste generation, which limits their commitment to reducing personal consumption, as well as environmental and human health [13,14].

In this context, education is key for citizens to recognise these relationships and an indispensable tool for awareness-raising and transformation action [15]. "This challenge specifically concerns teachers" [16] (p. 2), and requires their commitment to educational models oriented towards a systemic understanding of socio-ecological issues and the promotion of sustainable lifestyles [17].

Nonetheless, teachers often express their lack of mastery in sustainability issues, stating that they lack the knowledge and skills necessary to guide their students to recognise how their own well-being and health depend on their own actions [18,19]. In fact, the difficulties they have not only in an adequate perception of complex problems such as excessive waste generation but also in responsible involvement in the solution of these problems have been highlighted [20]. This could indicate deficiencies in developing the competencies needed to adequately address these challenges at school [21].

Considering the magnitude of the problem, the role of education, and, more specifically, the role of teachers in involving citizens in reducing consumption, this paper analyses the perceptions and commitments of future teachers to massive waste generation and the educational practices they propose. This might contribute to establishing educational guidelines for their teacher training in sustainability education.

2. Theoretical Framework

2.1. *The Problem of Massive Waste Generation from an Educational Perspective*

Education can provide future generations with the necessary tools to address current sustainability challenges [22]. Several authors point out that addressing socio-ecological issues in a reflective manner would contribute to a more holistic understanding of human and global health, helping to act responsibly, as intended by the One Health approach [3,23,24]. The One Health approach in education is aimed at raising public awareness of the impact that humans are having on the planet, including on each other, potentially compromising our collective sustainability [6].

However, these issues are complex and involve several barriers to understanding, related to the difficulty people have in perceiving the cause-effect relationships between our individual and collective actions and their multiple consequences, as well as to the proper understanding of the spatial and temporal scale in which these events occur [25].

In the specific context of massive waste generation, it is not always assumed that the continued demand for products implies a direct personal involvement in the problem [26], transferring the perceived responsibility to the productive industry [27]. Moreover, even when consumerism is recognised as the cause of the problem, it can be justified by linking it to economic growth and the generation of employment [28].

With regard to the consequences, there is a tendency to recognise only those of an ecological nature, with significant difficulties in identifying other types of impacts and how they affect us [16]. In this sense, the economic and social costs associated with the depreciation of environments, loss of primary resources or reduction of production in the primary sector are often not associated with waste generation—the resulting inequalities and challenges they pose to the achievement of One Health objectives are rarely recognised [20,29].

These aforementioned difficulties related to the recognition of personal involvement in causes and consequences suggest an incomplete understanding of the problem, which could hinder sustainable consumption choices [14,30]. Overcoming these difficulties would

require facilitating an analysis of one's own behaviours in terms of their current and future socio-ecological effects from a local and global perspective [31]. The aim is then to promote critical reasoning toward the causes of the problem and recognise the individual's own role and its consequences, together with the development of decision-making skills [32].

2.2. Commitments Generation to Address the Waste Problem

There is a growing concern among citizens about socio-ecological issues, yet there is often a lack of personal involvement [20]. This may be due to uncertainty or scepticism about the role of individual actions in reducing waste, which are often underestimated in the context of the global problem. This can lead to feelings of frustration or helplessness, which may hinder the adoption of the necessary behavioural changes [33,34]. Indeed, there is a widespread perception that it is other sectors which need to take action, especially the institutional and economic sectors [27,35].

In this context, the role of education is recognised as essential to encourage commitments, from the assumption of responsibility to a greater willingness to consume responsibly [31,36]. Nevertheless, the usual teaching approach at schools does not pay enough attention to the generation of these commitments, but it is often limited to the dissemination of information, which, on its own, does not allow for the personal involvement of learners [37]. This approach incorporates strategies such as explanations by the teacher, answers to questions or video viewing, where the role of the students is not active enough [38–40]. It is, therefore, education “about” sustainable development rather than “for” sustainable development [41], which does not encourage students to question their consumption habits, thus tending to reproduce established unsustainable patterns [16,22].

Therefore, it seems necessary to promote educational approaches that emphasise the development of sustainable values, attitudes and behaviours, creating learning situations in which students can question their own lifestyles [22,42].

2.3. Future Teachers with Regard to the Waste Problem

Teachers are key actors in the involvement of citizens in the promotion of the One Health approach [6]. It is in their hands to reach young people who have not yet established their habits and commitments. In this way, they could influence their intentions and decisions, as well as those of their families and society in general [43,44].

Most future teachers (FTs) are aware of the need to address socio-ecological issues with their students, involving them in their resolution [44,45]. Nevertheless, [32] point out that FTs often lack sufficient willingness and critical attitude to address the challenges of sustainability. Varela-Losada et al. found sceptical and indifferent profiles in relation to these issues among future teachers [16], and these authors question whether these profiles can drive what Redman and Redman [22] recognised as the necessary transformation to promote commitments from schools. In this sense, several studies have pointed out that teachers' motivation and their own representations of these problems have a significant effect on their teaching-learning proposals, as well as on their confidence in bringing them into the classroom [46,47]. In fact, FTs often question their own capacity to adequately address sustainability issues [18]. Indeed, some authors found that future secondary school teachers present a partial development of certain competences necessary to adequately address socio-ecological controversies with their students [48].

Therefore, from their initial training, it seems necessary to promote the figure of a reflective and involved teacher, with opportunities to explore new educational approaches that guide their students in responsible decision-making [49,50]. This is what Barth et al. [51] (p. 419) called “enabling didactics”, that is, didactic strategies that enable learners to confront socio-ecological conflicts, take responsibility and make decisions in a reflective way [52,53].

Hence, in order to guide initial teacher training in this regard, it is of interest to analyse the perceptions and commitments of future secondary school teachers regarding waste generation, the responsibility they take and the changes they are willing to make in their

habits, as well as to explore the educational approaches they propose for addressing this issue in secondary school classrooms, all within the framework of the One Health approach.

3. Research Questions

In this paper, we analyse how future teachers face the problem of massive waste generation in their dual roles as citizens and as education professionals. To this aim, we pose the following research questions:

1. What perceptions do future secondary school teachers have about massive waste generation in relation to its causes, consequences and possible solutions?
2. How much responsibility do FTs take for the problem, and what changes are they willing to make in their habits?
3. Which educational approaches do FTs propose for addressing this issue in secondary classrooms?

4. Methodology

The research carried out follows a descriptive non-experimental design, with a mixed approach, combining qualitative and quantitative analysis of the data obtained [54].

4.1. Participants

The study involved 138 FTs who were studying for a Master's degree in Secondary Education, specialising in Biology and Geology, at the Universities of xx (Spain). They ranged in age from 22 to 28 years, and the majority were women (56.4%). They were selected on a non-probabilistic basis and by convenience. At the time of data collection, they had already received training on didactic guidelines for dealing with socio-ecological controversies in the classroom, including the One Health approach.

4.2. Experimental Design

4.2.1. Instruments for Data Collection

A questionnaire was designed and validated by expert opinion within the framework of a larger project aimed at analysing professional competences in relation to the problem of massive waste generation. This questionnaire (Appendix A) is structured into three blocks of questions aligned with the dimensions to be analysed:

1. Perceptions of the problem (causes, consequences and possible solutions):
 - With regard to the causes, three questions are posed: PCa1, where FTs have to assess how different facts contribute to the problem using a 4-level scale (adapted from [55]). Meanwhile, in PCa2 and PCa3, FTs have to indicate the quantities of waste they believe that they produce at home and in their municipality, respectively.
 - With regard to consequences, a question (PCo) is posed for FTs to assess the influence of excessive waste production on twelve types of socio-ecological dimensions using a four-level scale [4].
 - With regard to possible solutions, two questions arise: in PSo1, FTs have to rank the relevance of five actions related to MSW management [9], while in PSo2, FTs have to describe an example of waste management that they consider to be exemplary.
2. Commitments assumed, where the degree of responsibility, their willingness to modify their habits and their behaviours are assessed [16,56]:
 - Regarding responsibility for the problem or conflict (CR), FTs have to assess their agreement on the responsibility of different sectors, including personal responsibility, using a four-level scale.
 - Regarding the willingness to change their habits (CW), FTs have to assess their level of agreement in adopting actions they could incorporate into their daily lives, including waste reduction, using a four-level scale.

- Regarding their behaviours (CB), FTs have to indicate the frequency with which they carry out different actions aimed at tackling excess waste.
3. Educational approaches, including a question on how to deal with excessive waste production in the classroom:
- Regarding educational interventions (EI), FTs have to describe the type of activity or activities they would implement in a secondary school classroom.

4.2.2. Criteria for Data Analysis

For the analysis of the obtained responses, different criteria were established for each of the dimensions and variables, which are described below (Table 1).

Table 1. Dimensions, features of the questions and categories of analysis.

	Dimensions and Questions	Type of Question	Categories of Analysis	
Perceptions of the problem	PCa1	Mark with an X to what extent you think the following facts can contribute to the socio-ecological problem of MSW generation.	Closed Likert-type Not at all A little Quite a lot Very much	
	PCa2	About how many kilograms of total waste (including products that can be recycled) do you think are generated per day in your household? How many of you are in your household?	Open	Far below Below Fits Above Far above
	PCa3	How many kilograms do you think are generated per day in your population? What is your population?	Open	
	PCo	To what extent do you think that the massive generation or poor management and treatment of Municipal Solid Waste can influence the following socio-ecological problems?	Closed Likert-type	Environmental Social Health Economic
	PSo1	Rank the following actions related to MSW management and treatment, where 1 represents the most favourable option from a socio-ecological point of view and 5 the least favourable.	Of order or rank	Reduction Energy recovery Reuse Disposal Recycling
	PSo2	Explain if you know of any examples of waste management (at local, national or international level) that you consider to be exemplary.	Open	Institutional Economic Collective Individual
				Reduction, Reuse Disposal
Commitments assumed	CR	Indicate (X) your degree of agreement or disagreement with the following statements:	Closed Likert-type Institutional Economic Collective Individual	
	CW	Indicate (X) your degree of agreement or disagreement with the following statements:	Closed Likert-type Priority to consumption reduction. No priority for consumption reduction.	
	CB	Indicate how often you carry out the following actions in your daily life:	Closed Guttman-type Priority to consumption reduction. No priority for consumption reduction.	

Table 1. Cont.

	Dimensions and Questions		Type of Question	Categories of Analysis
Commitments assumed	CR	Indicate (X) your degree of agreement or disagreement with the following statements:	Closed Likert-type	Institutional Economic Collective Individual
	CW	Indicate (X) your degree of agreement or disagreement with the following statements:	Closed Likert-type	Priority to consumption reduction. No priority for consumption reduction.
	CB	Indicate how often you carry out the following actions in your daily life:	Closed Guttman-type	Priority to consumption reduction. No priority for consumption reduction.
Educational approaches	EI	If, as a teacher, you were considering tackling this problem in the classroom, what would your teaching proposal be? Explain in detail the contents and learning objectives you would consider, as well as what tasks would be assigned to teachers and students.	Open	Approaches oriented to the transmission of information. Approaches oriented to the search for and handling of information. Approaches aimed at promoting critical thinking and reflection. Approaches oriented to promotion of action.

1. Perceptions of the problem

Regarding the causes, in PCa1 the analysis focused on determining the degree of contribution to the problem that they give to the different facts in order to identify the link they establish between waste generation and consumption patterns [34]. For the quantities of waste produced (PCa2 and PCa3), five ranges were established on the basis of official data [57], from well below to well above the regional average. In this way, it is possible to assess how close their perceptions are to the real situation.

Regarding the consequences (PCo), the analysis focused on the relevance associated with the different impacts, whether ecological, economic, social or health-related, aligned with the One Health approach. This allows us to approach the systemic perception of FTs regarding consequences [4].

For the assessment of solutions, the different waste management models stated by FTs were established in PSo1 on the basis of the order they establish between the different actions. Thus, a comparison between their models and the reference waste management hierarchy is possible [9]. On the other hand, the analysis of the management example (PSo2) was carried out by means of deductive content analysis using two criteria: (i) the involved spheres, differentiating between four categories (institutional, economic, collective and individual) [34]; and (ii) the management objective, identifying three categories (reduction, reuse or disposal) [9]. For the assignment of these categories, the responses of each participant were cross-checked in several cycles of analysis by two researchers, agreeing on a consensus version after an independent coding. To ensure the reliability of this analysis, Cohen's Kappa index was calculated, obtaining a value of $\kappa = 0.79$, indicating "substantial" agreement according to [58].

2. Commitments assumed

With respect to responsibility (CR), a comparative analysis was made of the level of responsibility they give to different spheres: individual, public administration, society and the business sector [27]. With respect to their willingness to change their habits (CW) and their behaviours (CB), the analysis focused on the priority they give to waste reduction [12,20].

3. Educational approaches

For the analysis of the proposed activities (EI), four educational approaches were used as coding categories for the content analysis according to their relevance for the acquisition of competences for sustainability [59,60]:

Approach 1 aimed at transmitting information and providing students with data and facts about the problem. This type of approach is dominated by the teacher's explanations, viewing of videos and pencil-and-paper activities based on questions.

Approach 2 aimed at promoting a certain degree of student involvement, giving them more of a leading role than in the previous approach but maintaining a strong dependence on the transmission of information. These are proposals such as bibliographical searches or practical activities in which instructionalism predominates and where student autonomy is limited.

Approach 3 is aimed at promoting critical thinking and reflection on real problems in local contexts and is associated with situations of socio-ecological conflict. These approaches focus on promoting interactive, participatory, experiential and action-oriented learning. This is the case for proposals based on simulation games or problem-posing and solving.

Approach 4 is aimed at promoting commitments, in which, in addition to critical thinking and reflection, explicit attention is paid to the analysis and adoption of individual commitments regarding one's own habits and participation in the community.

To determine the approach to which each proposal corresponded, categorisation was carried out by three researchers independently, and then an agreement was reached. As a measure of reliability in the process, Cohen's Kappa index was calculated, obtaining a value of $\kappa = 0.70$, indicating a "substantial" agreement between evaluators [58].

4.2.3. Data Treatment

For the exploratory data processing, descriptive statistics were used to describe the results obtained for each of the dimensions and their variables (perceptions of causes, consequences and solutions; commitments assumed; and educational approaches).

For each variable, the frequency of its categories was calculated, except for PCa1, PCo, CR and CW. In these questions, FTs had to rank the categories in a four-level agreement scale, so the mean obtained for each one was calculated, where values close to 4 indicate greater relevance or level of agreement.

In order to properly assess the scope of the results obtained in this study, the reliability of the data was confirmed (Cronbach's $\alpha = 0.71$). However, it is important to note that the number of participants limits the extrapolation of the results. On the other hand, we must consider that the analysis of educational approaches is carried out by assessing the design of educational proposals, not their implementation in the classroom. The latter could provide more accurate results for the analyses. Indeed, it would be interesting to conduct further analyses to include personal or contextual factors that have an effect on future teachers' educational practices.

5. Results

5.1. Perceptions of the Problem

5.1.1. About the Causes

When FTs evaluate the causes of the problem, they give similar importance to all causes, with average values higher than 3 out of 4 in all cases. When looking deeper into their assessments, it can be seen that FTs focus on over-consumption and over-packaging of products rather than lack of knowledge among citizens (Figure 1).

When estimating waste generation at home, the majority ($n = 88$) consider that their waste generation is below the regional average. When referring to what is produced in their municipality of residence, a high percentage continue to underestimate waste generation ($n = 61$). However, it is also noted that up to 40 respondents report data well above expectations. Therefore, two trends can be observed: a major part with those who underestimate domestic waste production, both personal and that of the population as a

whole, and a second one of those who perceive that their waste generation is lower than that of the general population in their region.

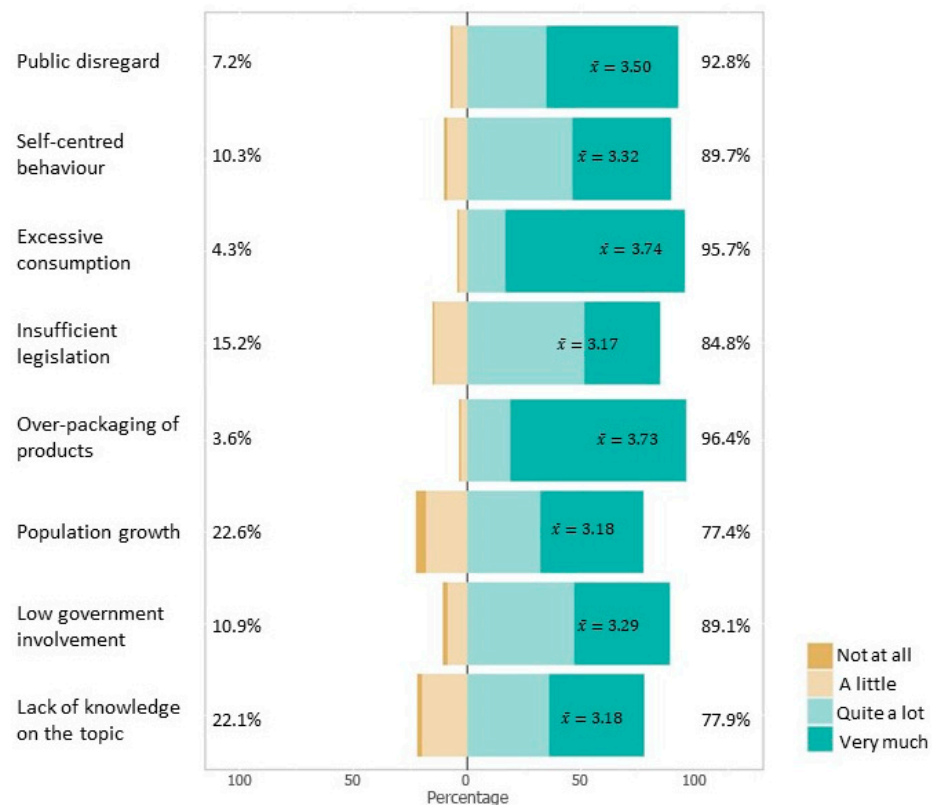


Figure 1. Assessment of the causes of the problem by means of the average value obtained by each possible cause. Percentages on the left indicate the frequency of selecting the options ‘not at all’ or ‘a little’ for each possible cause. Percentages on the right indicate the frequency of selecting the options ‘quite a lot’ or ‘very much’ for each possible cause.

5.1.2. About the Consequences

In general, the FTs recognise the importance of the different consequences, all obtaining averages above 3 out of 4, except for the one involving “Social inequalities and poverty” with a slightly lower rating (Figure 2). A greater emphasis is placed on ecological impacts, although at levels close to those related to health, in terms of pests and diseases.

5.1.3. About the Solutions

With regard to solutions, when FTs consider their management hierarchy, they mainly recognise reduction as the priority measure to manage waste, and rank its disposal last. When considering the set of measures, three hierarchy models with similar frequencies are observed (Figure 3): One-third of them do this hierarchy in line with the reference one [9] (model 1); another third underestimates reuse (model 2) or overestimates energy recovery (model 3); and the final third both undervalues reuse and overvalues energy recovery (model 4).

When trying to point to a reference model for waste management, the majority ($n = 87$) are not able to give an example. Among those who do ($n = 51$):

- Regarding the management model FTs identify, most of them refer to the use of waste through recycling. An example is participant 5 (FT5), who states, “In my locality, there are seven different bins. Also, there are mini-bins for batteries, so I think it is quite an efficient model”.
- With regard to the sphere involved, they mainly opt for the institutional sphere, with the participation of local councils. This is the case of FT94, who noted, “In some towns,

each day of the week, a type of waste is collected; the neighbours deposit their type of waste at a certain time in the street, and only the corresponding waste is collected. So everything is separated”.

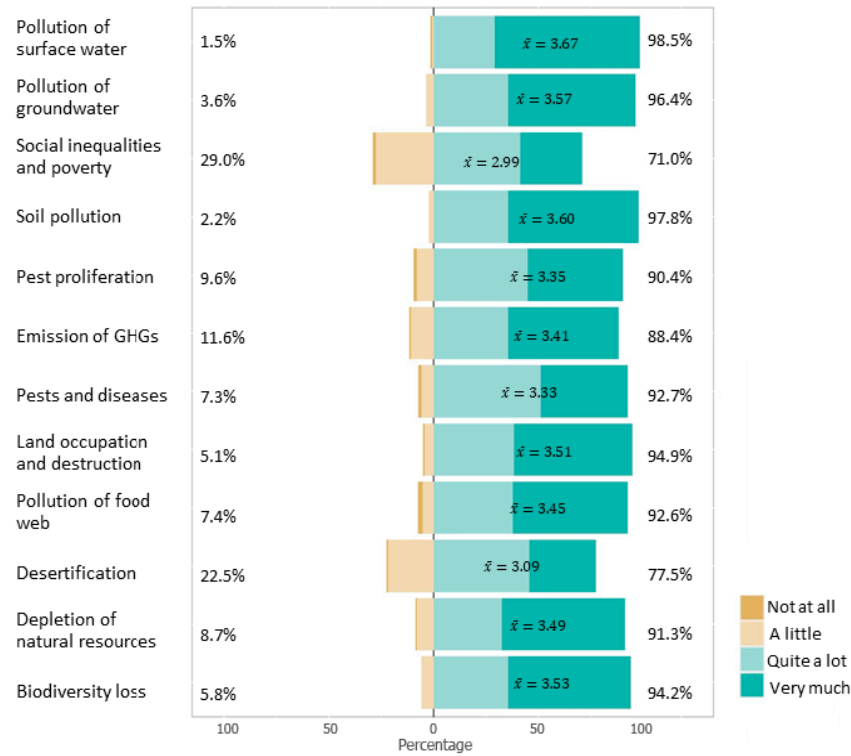


Figure 2. Assessment of different impacts associated with waste generation by means of the average value obtained. Percentages on the left indicate the frequency of selecting the options ‘not at all’ or ‘a little’ for each item. Percentages on the right indicate the frequency of selecting the options ‘quite a lot’ or ‘very much’ for each item.

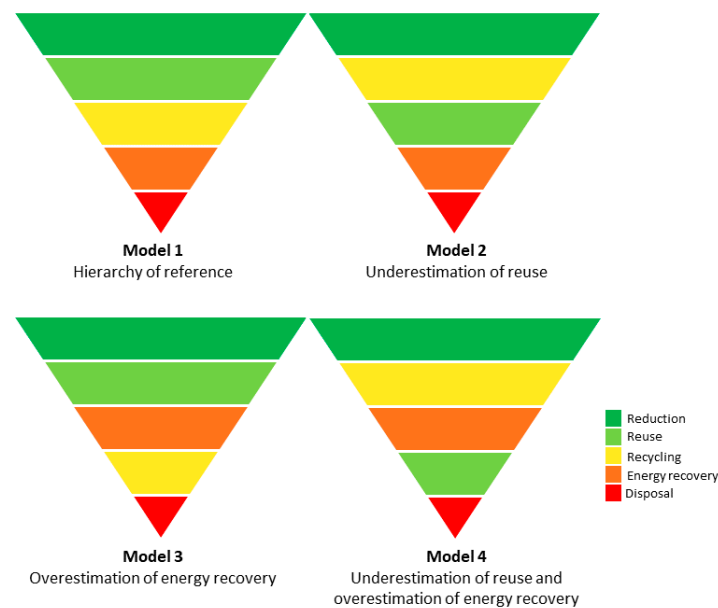


Figure 3. Most common representations of Waste Hierarchy.

Thus, examples focusing on recycling as a management measure and on the institutional level as the main actor dominate.

5.2. Commitments Assumed

5.2.1. Responsibilities for the Problem

In general, they attribute high importance to the responsibility to be assumed in all spheres, with average values above 3 (Figure 4); although seen in more detail, they give slightly more responsibility to the government, although these differences are not statistically significant. The responsibility given to companies is lower than to other sectors. Furthermore, they note they have the same personal responsibility as they do as part of society.

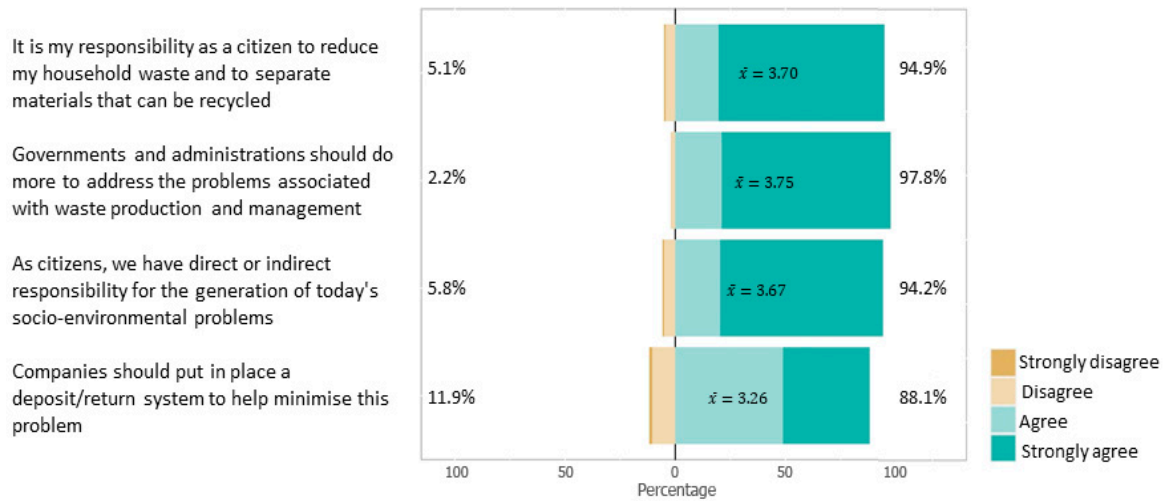


Figure 4. Assessment of the responsibility allocated to each social sphere by means of the average value obtained. Percentages on the left indicate the frequency of selecting the options ‘strongly disagree’ or ‘disagree’ for each social sphere. Percentages on the right indicate the frequency of selecting the options ‘agree’ or ‘strongly agree’ for each social sphere.

5.2.2. Willingness to Change Habits

In terms of their willingness to change their habits, the majority (n = 126) agree or strongly agree to reduce their consumption (Figure 5). However, where most disagreement is recorded, with up to one-fifth of FT, is in prioritising consumption reduction over recycling. In this sense, it can be seen that most FTs also attach great importance to the use of recyclable or recycled materials.

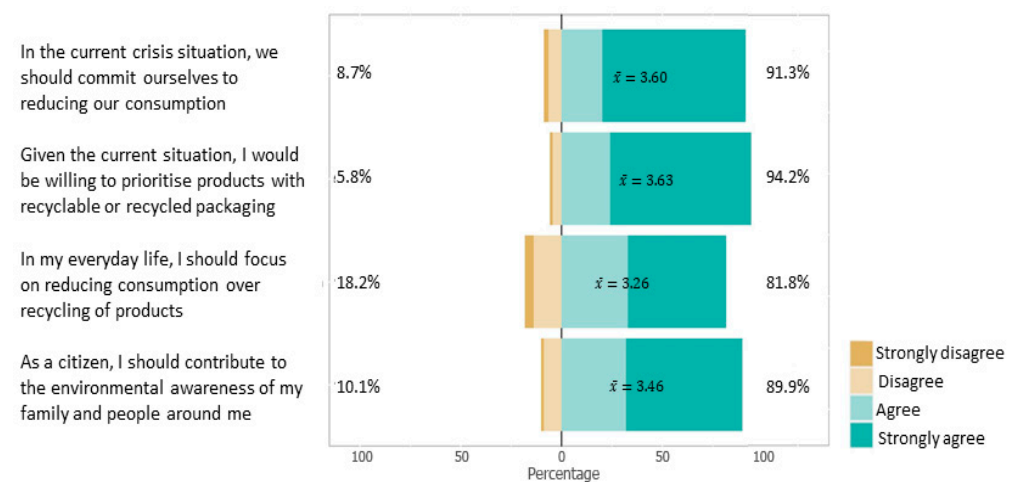


Figure 5. Assessment of willingness to change habits by means of the average value obtained by each item. Percentages on the left indicate the frequency of selecting the options ‘strongly disagree’ or ‘disagree’ for each item. Percentages on the right indicate the frequency of selecting the options ‘agree’ or ‘strongly agree’ for each item.

5.2.3. Behaviour

Future teachers (FTs) predominantly engage in waste separation activities, such as sorting recyclable materials, reflecting a strong emphasis on recycling (Figure 6). Nevertheless, their engagement in waste reduction and reuse is notably lower. Fewer FTs regularly adopt practices to minimise waste production, like reducing single-use plastics. Even fewer engage in reuse behaviours, such as repurposing items or repairing products. This indicates that while FTs are proactive in recycling, they show less commitment to reduction and reuse, suggesting a need for greater emphasis on these aspects of waste management.

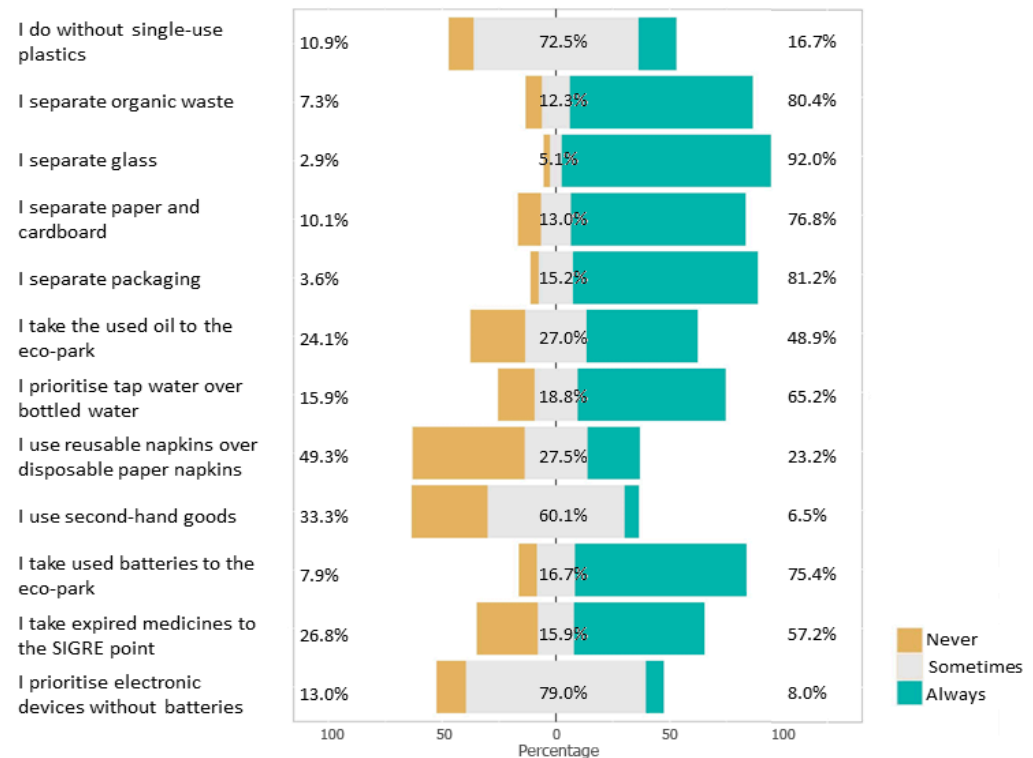


Figure 6. Frequency of adopting certain measures to minimise the waste problem by means of the average value obtained by each measure. Percentages on the left indicate the frequency of selecting the option ‘never’ for each measure. Percentages in the middle indicate the frequency of selecting the option ‘sometimes’ for each measure. Percentages on the right indicate the frequency of selecting the option ‘always’ for each measure.

5.3. Educational Approaches That They Propose to Address the Problem at School

The approaches proposed by FTs are dominated by educational proposals that rely heavily on the transmission of information about the problem. On the one hand, 49 participants base their approaches on providing learners with data and facts (approach 1). In particular, they propose to use videos to explain the problem, with a special focus on its consequences and more on ecology than on human health or social issues. They then propose pen-and-paper tasks, which consist of answering questions using the information received. On the other hand, 51 participants promote a certain involvement of pupils in various tasks aimed at gathering information on the problem (approach 2). For example, they propose organising pupils in groups to conduct literature searches on the internet and use this information to answer certain questions, prepare short reports or even make handicrafts with waste.

Less frequently ($n = 23$), FTs make approaches aimed at developing critical thinking about the problem without explicitly encouraging students to adopt specific commitments in this regard (approach 3). Thus, they propose carrying out eco-audits of nearby environments, such as schools or homes, in order to recognise how much waste is generated and

its origin and assess its management. They also set up role games in which students play the roles of different characters in relation to an issue concerning waste generation. An example could be how to improve waste management in a town or city to ensure social and environmental health as opposed to the proposal to set up a landfill site. Each character is associated with a level of the Waste Hierarchy, and the aim is to promote discussion on the effectiveness of different methods and the challenges of their implementation.

Only three participants promote the adoption of commitments, together with the development of critical thinking (approach 4), by proposing a class debate on any conflict arising from our consumption style and its implications for waste generation. The aim is for students to assess and discuss the influence of their own consumption decisions on such conflicts and on the lives and health of others, as well as establish personal strategies to make them sustainable by reducing their waste. Finally, each student must write a commitment letter for a more sustainable personal consumption, reducing their waste. Therefore, only these three FTs seem able to integrate the One Health approach in their educational proposals.

6. Discussion and Educational Implications

This paper analyses the perceptions and commitments of future secondary school teachers regarding the problem of massive waste generation. In addition, as future education professionals, we also analyse the educational approaches they recognise and propose to help their students integrate the One Health approach into their actions from the perspective of sustainability.

When analysing their perceptions of the possible causes of the problem, FTs give practically the same relevance to all of them. This could be because they consider that all these factors play a similar role in the origin of the problem, but it could also reflect difficulties in making a critical assessment of the relevance of each possible cause [27,61]. In addition, it is of interest that the majority perceive their own waste production to be lower than average in their region. This suggests that they may underestimate their personal contribution to the problem, which is in line with previous studies [27,62]. Therefore, when addressing these issues during teacher training programmes, it would be necessary to identify the sources of release of the different types of waste generated in our daily lives. This could help to achieve a better understanding of their causes, recognising the importance of consumption patterns and possible solutions based on alternatives that promote reuse and reduction [63].

Concerning consequences, FTs are able to identify ecological and health impacts, so this topic can be interesting to bring students closer to this holistic vision of One Health. In this sense, authors such as Hobusch et al. [6] point out how their participants show difficulties in tackling certain socio-scientific problems from this systemic approach that integrates One Health. Nonetheless, there are difficulties in identifying social impacts, such as inequalities. These connections are not always easy to establish due to the distance between the production of waste and its release and, in turn, its subsequent effects on the human organism [64]. Therefore, in their training, it will be necessary to emphasise the socio-ecological risks posed by waste and how each inhabitant contributes to this through their consumption [65]. For Kollmuss and Agyeman [66], becoming aware of the power of one's own behaviour, increasing one's internal locus of control (described by [35] (p. 172) as "the sense of control that one has over outcomes"), is the first step towards responsible decision-making.

Regarding possible solutions, FTs also have difficulties establishing the appropriate hierarchy for different management methods. In this study, most of them recognise reduction as the first management method and disposal as the last. However, almost half prioritise the use of waste already generated, recycling or opting for energy recovery, and underestimate reuse. Moreover, although most of them are not able to identify an exemplary model of waste management, when they do, they clearly favour waste recovery through recycling over waste reduction. Although there is currently progress in promoting reuse through the

second-hand market [67], there is still a certain reluctance to use these products [68], which are often associated with situations of lower social class considerations [28].

With regard to commitments, both the personal responsibility assumed by the FTs and their willingness to act has been assessed. With regard to the former, the vast majority assume co-responsibility for this problem. This degree of co-responsibility detected in the present study contrasts with studies such as that of Manolas and Tampakis [27], where responsibility was basically attributed to the economic and institutional sphere. Taking personal responsibility for sustainable solutions is crucial [69] and is embedded in social responsibility. This approach aims at achieving a collective response that embraces resilience as an integrative concept, linking health and sustainability concerns [21,70].

Clearly, the response to the socio-ecological crisis is not sufficient at the individual level, especially given the complexity of these issues, which could lead to feelings of frustration and helplessness [16]. Tackling them requires individual participation committed and decisively integrated into collective actions [71]. Some authors point out that “although transformation must come from the social sphere, it is necessary to promote it from personal empowerment” [16] (p. 14). Therefore, the focus on individual responsibility should not limit FTs from recognising the structural and systemic roots of these problems by critically analysing the economic and socio-political influences and the responsibility of the stakeholders involved [34].

However, accepting one’s own participation in the problem is key to favouring behavioural patterns compatible with a sustainable socio-ecological context so as to be able to contribute to the maintenance of global health [59,70], particularly in the context of domestic waste, where individual consumption decisions are decisive [12]. In this sense, among pre-service teachers, it is not common to identify strategies to reduce household waste and instead focus more on recycling [20]. The same pattern is observed in the present study: although the majority strongly agree that they should reduce their waste, they are keener to separate their waste for recycling. Several authors suggest that the perception of an advanced management system could be generating this loss of interest in reduction [12,43,72], ignoring the fact that the treatments to which waste is subjected also have negative effects on people’s health and well-being and are linked to the release of toxic substances and the emission of GHGs, especially when their management is transferred to low-income countries [73–75].

Furthermore, we have to bear in mind that a willingness to reduce consumption does not necessarily translate into desirable changes, given the level of effort required [76]. Citizens need reinforcement when they intend to adopt such changes [27], either by the obligation derived from institutional regulations (external reinforcement) or by the existence of strategies that facilitate this change (internal reinforcement).

Furthermore, “often environmental education programs encourage simple actions, such as recycling” [76] (p. 2). This can trivialise the problem of waste generation by encouraging the idea that it can be solved by simple behaviours [69]. Therefore, when addressing the waste problem in teacher training, it is essential that the effectiveness of different solutions is also considered, with explicit reference to the limitations of recycling, since the perceived effectiveness of consumers is the most influential variable in predicting intentions to reduce their waste [77]. For these authors, the locus of control, with a strong expectation of one’s own activities, is essential for enhancing the willingness to act. Thus, a responsible person who considers socio-ecological issues that interfere with a sustainable and healthy environment to be important and who is also confident that effective action is possible will be more likely to adopt sustainable behaviours [78].

Regarding educational approaches, when designing their own activities on the massive production of MSW, we observe certain difficulties in developing approaches oriented towards this transformation, which are mostly limited to favouring knowledge acquisition and not promoting action to the same extent. Among the constraints to implementing action-oriented approaches, teachers highlight a lack of time, overly long curricula, and even their lack of confidence to address sustainability issues in the classroom [79]. In

fact, several studies point to inconsistencies between what teachers want to do about sustainability in their classrooms and their actual practice [21,80].

Thus, teacher training should promote the development of professional competences for the necessary pedagogical transformation required to engage students regarding the current severe socio-ecological crisis. That is to say, to address pedagogical practices in education for sustainable development, which, in the specific case of the waste issue, means carrying out educational approaches aimed at achieving behaviours conducive to the reduction of consumption [11,12]. In this way, they would engage their students as agents of change towards sustainability, motivating them to take individual and collective actions that help to preserve a healthy socio-ecological system [2,4,31,77,81].

7. Conclusions and Future Directions

Considering the research questions raised and assuming the aforementioned limitations of this paper, it is possible to conclude:

1. In terms of perceptions, although FTs recognise excessive consumption as the cause of the problem, they also tend to underestimate the production of waste generated. As for the consequences, in addition to the ecological ones, those related to health are recognised. Meanwhile, there are greater difficulties in identifying social inequalities. In terms of solutions, the general tendency is to overestimate waste recycling.
2. On commitments, FTs assume a co-responsibility to the problem, and although the need to reduce consumption is identified, they focus more on recycling in their daily habits.
3. The approaches proposed by FTs are dominated by educational proposals oriented to the transmission or gathering of information on the problem. Thus, their proposals aim to reduce knowledge gaps rather than to generate engagement among students.

For future research directions, it would be interesting to analyse the educational practices implemented in the classroom and how they are influenced by teachers' level of understanding of the problem and their habits related to consumption and waste generation. This will allow us to explore whether those teachers with a profile committed to this problem on a personal level are more likely to orient their educational practices towards generating commitment among their students [16].

Author Contributions: Conceptualization, U.O.-L., P.E.-G., J.R.D. and I.B.-G.; Formal analysis, M.Á.G.-F. and A.R.-N.; Methodology, M.Á.G.-F. and O.B.; Project administration, I.B.-G.; Validation, D.Z. and M.V.-P.; Writing—original draft, M.Á.G.-F., P.E.-G. and I.B.-G.; Writing—review and editing, M.Á.G.-F., U.O.-L., P.E.-G., O.B., A.R.-N., D.Z., M.V.-P., J.R.D. and I.B.-G. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by AGENCIA ESTATAL DE INVESTIGACIÓN (Ministerio de Ciencia e Innovación, Gobierno de España), grant number PID2019-105705RA-I00/AEI/10.13039/501100011033 and The APC was funded by PID2019-105705RA-I00/AEI/10.13039/501100011033.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the University of Murcia (protocol code 2526/2019, 15 November 2019).

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

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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

Appendix A. The Questionnaire

PCa1. Mark with an X to what extent you think the following facts can contribute to the socio-ecological problem of MSW (municipal solid waste) generation.

	Not at all	A little	Quite a lot	Very much
Public disregard				
Self-centred behaviour				
Excessive consumption				
Insufficient legislation				
Over-packaging of products				
Population growth				
Low government involvement				
Lack of Knowledge on the topic				

PCa2. About how many kilograms of total waste (including products that can be recycled) do you think are generated per day by your household? _____

How many people live in your house? _____

PCa3. How many kilograms do you think are generated per day in your region? _____

What is your population or region? _____

PCo. To what extent do you think that the massive generation or poor management and treatment of Municipal Solid Waste can influence the following socio-ecological problems?

	Not at all	A little	Quite a lot	Very much
Pollution of surface water				
Pollution of groundwater				
Social inequalities and poverty				
Soil pollution				
Pest proliferation				
Emission of GHGs				
Pest and diseases				
Land occupation and destruction				
Pollution of food web				
Desertification				
Depletion of natural resources				
Biodiversity loss				

PSo1. Rank the following actions related to MSW management and treatment, where 1 represents the most favourable option from a socio-ecological point of view and 5 the least favourable.

Reduction of the amount of waste	
Energy recovery (use of waste to obtain energy in the form of heat, electricity or fuel)	
Re-use of waste (checking, cleaning and/or repairing for re-use of waste, not involving processing)	
Disposal (landfilling or exporting waste)	
Waste recycling (transformation of waste for new use)	

PSo2. Explain if you know of any examples of waste management (at local, national or international level) that you consider to be exemplary.

CR. Indicate (X) your degree of agreement or disagreement with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree
It is my responsibility as a citizen to reduce my household waste and to separate materials that can be recycled				
Governments and administrations should do more to address the problems associated with waste production and management				
As citizens, we have direct or indirect responsibility for the generation of today's socio-environmental problems				
Companies should put in place a deposit/return system to help minimise this problem				

CW. Indicate (X) your degree of agreement or disagreement with the following statements:

	Strongly disagree	Disagree	Agree	Strongly agree
In the current crisis situation, we should commit ourselves to reducing our consumption				
Given the current situation, I would be willing to prioritise products with recyclable or recycled packaging				
In my everyday life, I should focus on reducing consumption over recycling of products				
As a citizen, I should contribute to the environmental awareness of my family and people around me				

CB. Indicate how often you carry out the following actions in your daily life:

	Never	Sometimes	Always
I do without single-use plastics			
I separate organic waste			
I separate glass			
I separate paper and cardboard			
I separate packaging			
I take the used oil to the eco-park			
I prioritise tap water over bottled water			
I use reusable napkins over disposable paper napkins			
I used second-hand goods			
I take used batteries to the eco-park			
I take expired medicines to the SIGRE point			
I prioritise electronic devices without batteries			

EI. If, as a teacher, you were considering tackling this problem in the classroom, what would your teaching proposal be? Explain in detail the contents and learning objectives you would consider, as well as what tasks would be assigned to teachers and students.

References

1. Bagheri, M.; Esfilar, R.; Sina, M.; Kennedy, A.C. Towards a circular economy: A comprehensive study of higher heat values and emission potential of various municipal solid wastes. *Waste Manag.* **2020**, *101*, 210–221. [CrossRef] [PubMed]
2. Bunch, M.J. Ecosystem Approaches to Health and Well-Being: Navigating Complexity, Promoting Health in Social–Ecological Systems. *Syst. Res. Behav. Sci.* **2016**, *33*, 614–632. [CrossRef]
3. Harrison, S.; Kivuti-Bitok, L.; Macmillan, A.; Priest, P. EcoHealth and One Health: A theory-focused review in response to calls for convergence. *Environ. Int.* **2019**, *132*, 105058. [CrossRef] [PubMed]
4. United Nations Environment Programme (UNEP). Global Environment Outlook–GEO-6: Healthy Planet, Healthy People. 2019. Available online: <https://wedocs.unep.org/20.500.11822/27539> (accessed on 30 December 2023).
5. Wilson, D.C.; Velis, C.A. Waste management—still a global challenge in the 21st century: An evidence-based call for action. *Waste Manag. Res.* **2015**, *33*, 1049–1051. [CrossRef]
6. Hobusch, U.; Scheuch, M.; Heuckmann, B.; Hodžić, A.; Hobusch, G.M.; Rammel, C.; Pfeffer, A.; Lengauer, V.; Froehlich, D.E. One Health Education Nexus: Enhancing synergy among science-, school-, and teacher education beyond academic silos. *Front. Public Health* **2024**, *11*, 1337748. [CrossRef] [PubMed]
7. Kaza, S.; Yao, L.; Bhada-Tata, P.; Van Woerden, F. *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*; World Bank: Washington, DC, USA, 2018.
8. Al-Salem, S.M.; Lettieri, P.; Baeyens, J. Recycling and recovery routes of plastic solid waste (PSW): A review. *Waste Manag.* **2009**, *29*, 2625–2643. [CrossRef] [PubMed]
9. Bourguignon, D. Circular Economy Package: Four Legislative Proposals on Waste. Briefing EU Legislation in Progress. European Parliamentary Research Service, 2018. Available online: [https://www.europarl.europa.eu/RegData/etudes/BRIE/2018/614766/EPRS_BRI\(2018\)614766_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2018/614766/EPRS_BRI(2018)614766_EN.pdf) (accessed on 30 January 2024).
10. Lehtonen, A.; Salonen, A.O.; Cantell, H. Climate Change Education: A New Approach for a World of Wicked Problems. In *Sustainability, Human Well-Being, and the Future of Education*; Cook, J.W., Ed.; Springer International Publishing: Cham, Switzerland, 2018; pp. 339–374.
11. Cho, M. Campus sustainability: An integrated model of college students’ recycling behavior on campus. *Int. J. Sustain. Higher Ed.* **2019**, *20*, 1042–1060. [CrossRef]
12. Goldman, D.; Alkaher, I.; Aram, I. “Looking garbage in the eyes”: From recycling to reducing consumerism- transformative environmental education at a waste treatment facility. *J. Environ. Educ.* **2021**, *52*, 398–416. [CrossRef]
13. Fernández Manzanal, R.; Hueto Pérez de Heredia, A.; Rodríguez Barreiro, L.; Marcén Albero, C. ¿Qué miden las escalas de actitudes? Análisis de un ejemplo para conocer la actitud hacia los residuos urbanos. *Ecosistemas* **2003**, *11*, 11–27. Available online: <https://www.revistaecosistemas.net/index.php/ecosistemas/article/view/347> (accessed on 20 December 2023).
14. Wynes, S.; Nicholas, K.A. The climate mitigation gap: Education and government recommendations miss the most effective individual actions. *Environ. Res. Lett.* **2017**, *12*, 074024. [CrossRef]
15. United Nations Educational, Scientific and Cultural Organization (UNESCO). Berlin Declaration on Education for Sustainable Development. In Proceedings of the UNESCO World Conference on Education for Sustainable Development, Berlin, Germany, 17–19 May 2021; German Commission for UNESCO Federal Ministry of Education and Research. Available online: <https://unesdoc.unesco.org/ark:/48223/pf0000381229> (accessed on 12 April 2024).
16. Varela-Losada, M.; Vega-Marcote, P.; Lorenzo-Rial, M.; Pérez-Rodríguez, U. The Challenge of Global Environmental Change: Attitudinal Trends in Teachers-In-Training. *Sustainability* **2021**, *13*, 493. [CrossRef]
17. Palmberg, I.; Hofman-Bergholm, M.; Jeronen, E.; Yli-Panula, E. Systems Thinking for Understanding Sustainability? Nordic Student Teachers’ Views on the Relationship between Species Identification, Biodiversity and Sustainable Development. *Educ. Sci.* **2017**, *7*, 72. [CrossRef]
18. Dahl, T. Prepared to Teach for Sustainable Development? Student Teachers’ Beliefs in Their Ability to Teach for Sustainable Development. *Sustainability* **2019**, *11*, 1993–2003. [CrossRef]
19. Solís-Espallargas, C.; Ruiz-Morales, J.; Limón-Domínguez, D.; Valderrama-Hernández, R. Sustainability in the University: A Study of Its Presence in Curricula, Teachers and Students of Education. *Sustainability* **2019**, *11*, 6620. [CrossRef]
20. Martínez-Borreguero, G.; Maestre-Jiménez, J.; Mateos-Núñez, M.; Naranjo-Correa, F.L. Analysis of Environmental Awareness, Emotions and Level of Self-Efficacy of Teachers in Training within the Framework of Waste for the Achievement of Sustainable Development. *Sustainability* **2020**, *12*, 2563. [CrossRef]
21. Pegalajar-Palomino, M.C.; Burgos García, A.; Martínez Valdivia, E. What does education for sustainable development offer in initial teacher training? A systematic review. *J. Teach. Educ. Sustain.* **2021**, *23*, 99–114. [CrossRef]
22. Redman, E.; Redman, A. Transforming sustainable food and waste behaviors by realigning domains of knowledge in our education system. *J. Clean. Prod.* **2014**, *64*, 147–157. [CrossRef]
23. Hollweg, K.S.; Taylor, J.R.; Bybee, R.W.; Marcinkowski, T.J.; McBeth, W.C.; Zoido, P. *Developing a Framework for Assessing Environmental Literacy*; North American Association for Environmental Education: Washington, DC, USA, 2011. Available online: <https://cdn.naaee.org/sites/default/files/inline-files/devframeworkassessenvliltonlineed.pdf> (accessed on 12 May 2024).
24. Zinsstag, J. Convergence of ecohealth and one health. *EcoHealth* **2012**, *9*, 371–373. [CrossRef]
25. Cox, M.; Elen, J.; Steegen, A. Fostering students geographic systems thinking by enriching causal diagrams with scale. Results of an intervention study. *Int. Res. Geogr. Environ.* **2019**, *29*, 112–128. [CrossRef]

26. Efing, A.C.; Gomes, L. La responsabilidad compartida de los residuos posconsumo en el combate contra la contaminación transfronteriza. *Ius Et Veritas* **2014**, *24*, 92–106. Available online: <https://revistas.pucp.edu.pe/index.php/iusetveritas/article/view/13617> (accessed on 9 January 2024).
27. Manolas, E.; Tampakis, S. Environmental Responsibility: Teachers' Views. *J. Teach. Educ. Sustain.* **2010**, *12*, 27–36. [[CrossRef](#)]
28. Marcén, C.; Fernández Manzanal, R.; Hueto, A. ¿Se pueden modificar algunas actitudes de los adolescentes frente a las basuras? *Investig. En La Esc.* **2002**, *46*, 63–77.
29. Bourn, D.; Soysal, N. *Education for Sustainable Development (ESD) in Initial Teacher Training Programmes at the UCL Institute of Education*; DERC Research Paper no. 22; UCL Institute of Education: London, UK, 2020.
30. Kortland, J. Garbage: Dumping, burning and reusing/recycling: Students' perception of the waste issue. *Int. J. Sci. Educ.* **1997**, *19*, 65–77. [[CrossRef](#)]
31. United Nations Educational, Scientific and Cultural Organization (UNESCO). *Education for the Sustainable Development Goals: Learning Objectives*; UNESCO: Paris, Francia, 2017. Available online: <https://unesdoc.unesco.org/ark:/48223/pf0000252423?locale=es> (accessed on 19 April 2024).
32. Pérez-Rodríguez, U.; Varela-Losada, M.; Lorenzo-Rial, M.; Vega-Marcote, P. Attitudinal Trends of Teachers-in-training on Transformative Environmental Education. *Rev. Psicodidact.* **2017**, *22*, 60–68. [[CrossRef](#)]
33. Connell, S.; Fien, J.; Lee, J.; Sykes, H.; Yencken, D. If It Doesn't Directly Affect You, You Don't Think about It': A Qualitative Study of Young People's Environmental Attitudes in Two Australian Cities. *Environ. Educ. Res.* **1999**, *5*, 95–113. [[CrossRef](#)]
34. Waldron, F.; Ruane, B.; Oberman, R.; Morris, S. Geographical Process or Global Injustice? Contrasting Educational Perspectives on Climate Change. *Environ. Educ. Res.* **2016**, *25*, 895–911. [[CrossRef](#)]
35. Fielding, K.S.; Head, B.W. Determinants of young Australians' environmental actions: The role of responsibility attributions, locus of control, knowledge and attitudes. *Environ. Educ. Res.* **2012**, *18*, 171–186. [[CrossRef](#)]
36. Woo, Y.; Mokhtar, M.; Komoo, I.; Azamn, N. Education for sustainable development: A review of characteristics of sustainability curriculum. *Int. J. Sust. Dev.* **2012**, *3*, 33–44. Available online: <https://ssrn.com/abstract=2031102> (accessed on 2 April 2024).
37. Wi, A.; Chang, C. Promoting pro-environmental behaviour in a community in Singapore—from raising awareness to behavioural change. *Environ. Educ. Res.* **2019**, *25*, 1019–1037. [[CrossRef](#)]
38. Barrett, M. Education for the environment: Action competence, becoming, and story. *Environ. Educ. Res.* **2006**, *12*, 503–511. [[CrossRef](#)]
39. Gil-Flores, J. Rasgos del profesorado asociados al uso de diferentes estrategias metodológicas en las clases de ciencias. *Ensen. Cienc.* **2017**, *35*, 175–192. Available online: <https://raco.cat/index.php/Ensenanza/article/view/319574> (accessed on 1 April 2024).
40. Martín, C.; Prieto, T.; Jiménez, M.A. Tendencias del profesorado de ciencias en formación inicial sobre las estrategias metodológicas en la enseñanza de las ciencias. Estudio de un caso en Málaga. *Ensen. Cienc.* **2015**, *33*, 167–184. Available online: <https://raco.cat/index.php/Ensenanza/article/view/288577> (accessed on 4 December 2023).
41. López, R.; Jiménez, M.P. ¿Hace el profesorado verdaderamente educación ambiental cuando cree que la hace? Análisis de algunas claves para responder esta cuestión. *Innovación Educ.* **2004**, *14*, 149–170. Available online: <http://hdl.handle.net/10347/5023> (accessed on 20 December 2023).
42. Bourn, D.; Kalsoom, Q.; Soysal, N.; Ince, B. *Student Teachers' Understanding and Engagement with Education for Sustainable Development (ESD) in England, Türkiye (Turkey) and Pakistan*; Development Education Research Centre, Research Paper no. 23; UCL Institute of Education: London, UK, 2023.
43. Kolbe, K.D. Knowledge, Attitudes and Behaviour regarding Waste Management in a Grammar and a Comprehensive School in England Results from a School Questionnaire. *J. Teach. Educ. Sustain.* **2015**, *17*, 58–71. [[CrossRef](#)]
44. Stöckert, A.; Bogner, F. Cognitive Learning about Waste Management: How Relevance and Interest Influence Long-Term Knowledge. *Educ. Sci.* **2020**, *10*, 102. [[CrossRef](#)]
45. Bezeljak, P.; Scheuch, M.; Torkar, G. Understanding of sustainability and education for sustainable development among pre-service biology teachers. *Sustainability* **2020**, *12*, 6892. [[CrossRef](#)]
46. Almeida, A.; García-Fernández, B.; Sánchez, G. Assessment of pre-service teachers' knowledge of the impact of livestock production on global warming: A comparative study between Portugal and Spain. *Int. J. Environ. Stud.* **2016**, *73*, 939–953. [[CrossRef](#)]
47. Mahler, D.; Großschedl, J.; Harms, U. Does motivation matter? The relationship between teachers' self-efficacy and enthusiasm and students' performance. *PLoS ONE* **2018**, *13*, e0207252. [[CrossRef](#)]
48. García-Fortes, M.A.; Banos-González, I.; Esteve-Guirao, P. ESD action competencies of future teachers: Self-perception and competence profile analysis. *Int. J. Sustain. Higher Ed.* **2024**, *in press*. [[CrossRef](#)]
49. Murphy, C.; Mallon, B.; Smith, G.; Kelly, O.; Pitsia, V.; Martínez Sainz, G. The influence of a teachers' professional development programme on primary school pupils' understanding of and attitudes towards sustainability. *Environ. Educ. Res.* **2021**, *27*, 1011–1036. [[CrossRef](#)]
50. Prosser, G.; Rojas-Andrade, R.; Caro Zúñiga, C.; Schröder Navarro, E.; Romo-Medina, I. Determinants of the implementation of participatory actions in the environmental education with children and adolescents in Chile. *Environ. Educ. Res.* **2023**, *30*, 794–806. [[CrossRef](#)]

51. Barth, M.; Godemann, J.; Rieckmann, M.; Stoltenberg, U. Developing key competencies for sustainable development in higher education. *Int. J. Sustain. Higher Ed.* **2007**, *8*, 416–430. [CrossRef]
52. Lambrechts, W.; Van Petegem, P. The interrelations between competences for sustainable development and research competences. *Int. J. Sustain. Higher Ed.* **2016**, *17*, 776–795. [CrossRef]
53. United Nations Educational, Scientific and Cultural Organization (UNESCO). *Education 2030. Incheon Declaration and Framework of Action for the Realization of the Sustainable Development Goal4*; UNESCO: Paris, Francia, 2016. Available online: <http://unesdoc.unesco.org/images/0024/002456/245656s.pdf> (accessed on 6 April 2024).
54. Ivankova, N.V.; Plano Clark, V.L. Teaching mixed methods research: Using a socio-ecological framework as a pedagogical approach for addressing the complexity of the field. *Int. J. Soc. Res. Method.* **2018**, *21*, 409–424. [CrossRef]
55. Van Petegem, P.; Blicke, A.; Van Ongevalle, J. Conceptions and Awareness Concerning Environmental Education: A Zimbabwean Case-study in Three Secondary Teacher Education Colleges. *Environ. Educ. Res.* **2007**, *13*, 287–306. [CrossRef]
56. Banos-González, I.; Esteve-Guirao, P.; Jaén, M. Future teachers facing the problem of climate change: Meat consumption, perceived responsibility, and willingness to act. *Environ. Educ. Res.* **2021**, *27*, 1618–1637. [CrossRef]
57. EUROSTAT. Municipal Waste Statistics. 2023. Available online: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Archive:Estad%C3%ADsticas_sobre_residuos (accessed on 5 June 2023).
58. Landis, J.R.; Koch, G.G. An application of hierarchical kappa-type statistics in the assessment of majority agreement among multiple observers. *Biometrics* **1977**, *33*, 363–374. [CrossRef] [PubMed]
59. Cebrián, G.; Junyent, M. Competencias profesionales en Educación para la Sostenibilidad: Un estudio exploratorio de la visión de futuros maestros. *Ensen. Cienc.* **2014**, *32*, 29–49. [CrossRef]
60. Redman, E. Advancing educational pedagogy for sustainability: Developing and implementing programs to transform behavior. *Int. J. Environ. Sci. Educ.* **2013**, *8*, 1–34. Available online: <http://www.ijese.net/makale/1558.html> (accessed on 5 May 2023).
61. Birdsall, S. Measuring student teachers' understandings and self-awareness of sustainability. *Environ. Educ. Res.* **2014**, *20*, 814–835. [CrossRef]
62. Bourn, D.; Soysal, N. Transformative Learning and Pedagogical Approaches in Education for Sustainable Development: Are Initial Teacher Education Programmes in England and Turkey Ready for Creating Agents of Change for Sustainability? *Sustainability* **2021**, *13*, 8973. [CrossRef]
63. Brias-Guinart, A.; Markus Högmander, T.A.; Heriniaina, R.; Cabeza, M. A better place for whom? Practitioners' perspectives on the purpose of environmental education in Finland and Madagascar. *J. Environ. Educ.* **2023**, *54*, 163–180. [CrossRef]
64. García-Vázquez, E.; García-Ael, C. The invisible enemy. Public knowledge of microplastics is needed to face the current microplastics crisis. *Sustain. Prod. Consump.* **2021**, *28*, 1076–1089. [CrossRef]
65. Baierl, T.; Bogner, F.X. Plastic Pollution: Learning Activities from Production to Disposal-From Where Do Plastics Come & Where Do They Go? *Am. Biol. Teach.* **2021**, *83*, 320–324. [CrossRef]
66. Kollmuss, A.; Agyeman, J. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environ. Educ. Res.* **2002**, *8*, 239–260. [CrossRef]
67. European Commission. EU Strategy for Textiles. 2021. Available online: https://environment.ec.europa.eu/strategy/textiles-strategy_en (accessed on 5 June 2023).
68. Silván, P.; Silván-Martínez, P.; Trespalacions, J.A.; Fernández, I. Sostenibilidad y economía circular en el sector textil: Análisis del consumo de ropa de segunda mano como alternativa de moda sostenible. *Behanomics* **2023**, *1*, 82–98. [CrossRef]
69. Gyberg, P.; Anshelm, J.; Hallström, J. Making the Unsustainable Sustainable: How Swedish Secondary School Teachers Deal with Sustainable Development in Their Teaching. *Sustainability* **2020**, *12*, 8271. [CrossRef]
70. Bunch, M.J.; Morrison, K.E.; Parkes, M.W.; Venema, H.D. Promoting health and well-being by managing for social-ecological resilience: The potential of integrating ecohealth and water resources management approaches. *Ecol. Soc.* **2011**, *16*, 6. [CrossRef]
71. Sinakou, E.; Donche, V.; Van Petegem, P. Teachers' profiles in education for sustainable development: Interests, instructional beliefs, and instructional practices. *Environ. Educ. Res.* **2023**, *30*, 397–418. [CrossRef]
72. Catlin, J.R.; Wang, Y. Recycling Gone Bad: When the Option to Recycle Increases Resource Consumption. *J. Consum. Psychol.* **2012**, *23*, 122–127. [CrossRef]
73. Allsopp, M.; Costner, P.; Johnston, P. Incineration and human health. State of knowledge of the impacts of waste incinerators on human health. *Environ. Sci. Pollut. Res. Int.* **2001**, *8*, 141–145. [CrossRef]
74. European Environment Agency (EEA). Not in My Back Yard—International Shipments of Waste and the Environment. 2016. Available online: <https://www.eea.europa.eu/articles/international-shipments-of-waste-and-the-environment> (accessed on 17 July 2023).
75. United Nations Environment Programme (UNEP). Towards a Pollution-Free Planet: Background Report. 2017. Available online: <https://www.unep.org/resources/report/towards-pollution-free-planet-background-report> (accessed on 17 December 2023).
76. Ernst, J.; Blood, N.; Beery, T. Environmental action and student environmental leaders: Exploring the influence of environmental attitudes, locus of control, and sense of personal responsibility. *Environ. Educ. Res.* **2017**, *23*, 149–175. [CrossRef]
77. Hwang, Y.; Kim, S.; Jeng, J.M. Examining the Causal Relationships among Selected Antecedents of Responsible Environmental Behavior. *J. Environ. Educ.* **2000**, *31*, 19–25. [CrossRef]
78. Aarnio-Linnanvuori, E. How do teachers perceive environmental responsibility? *Environ. Educ. Res.* **2019**, *25*, 46–61. [CrossRef]

79. Evans, N.; Whitehouse, H.; Hickey, R. Pre-service teachers' conceptions of education for sustainability. *Aust. J. Teach. Educ.* **2012**, *37*, 1–12. [[CrossRef](#)]
80. Jaén, M.; Esteve, P.; Banos-González, I. Los futuros maestros ante el problema de la contaminación de los mares por plásticos y el consumo. *REurEDC* **2019**, *16*, 1501. [[CrossRef](#)]
81. Rieckmann, M. Learning to transform the world: Key competencies in Education for Sustainable Development. In *Issues and Trends in Education for Sustainable Development*; Leicht, A., Heiss, J., Byun, W.J., Eds.; UNESCO: Paris, France, 2018; pp. 39–59.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.