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Knowledge Analysis of the Prospective Secondary School Teacher on a Key Concept in Sustainability: Waste

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Abstract: The framework of sustainable development encompasses a series of behaviours which include the proper management of the waste we produce. This concept should be addressed in classrooms to ensure proper waste management. The amount of knowledge of the teachers and the inclusion of these concepts in the education curricula are essential factors when providing proper teaching about waste and waste management. The general objective was to analyse the amount of knowledge about waste of teachers in training within the framework of sustainable development. The sample consisted of 72 secondary school teachers in training belonging to three scientific-technological areas (Physics & Chemistry, Biology & Geology, and Technology). The methodology used was exploratory and quantitative. As a measuring instrument, a questionnaire was elaborated based on the educational curricula and based on previous research, made up of five categories (Waste and Society, Regulations, Awareness, Technological Development, and Typology). The results of the study show that teachers in training lack knowledge regarding waste. Within teacher education programs, it is, therefore, necessary to address issues of sustainability including waste in order to prepare teachers that are competent and willing to teach such important topics.

Keywords: sustainability; teacher in training; waste; environmental education; knowledge

1. Introduction

The concept of sustainable development is an element of special relevance to our society due to the environmental crisis we are experiencing. One of the key elements influencing the concept of sustainability is the concept of waste. Poor waste management has irreparable environmental repercussions, such as the uncontrolled dumping of harmful and polluting elements or the uncontrolled disposal of hazardous waste, among others. It has been internationally recognized that the state of civilizational crisis in which the planet finds itself implies assuming society/nature relations on a large scale [1,2]. The increase in waste production, the scarcity of landfills and the adverse long-term environmental, economic and social impacts of the waste generated means that sustainable management is essential to protect public health and natural ecosystems [3].

The imminent quest for sustainability has involved numerous institutions in the development of policies and strategies to reduce waste production by 50% [4,5]. Along these lines, various approaches have been taken to collect detailed quantitative data on the quantity, location, and characteristics of the waste produced, in addition to reviewing waste management records and conducting visual assessments and interviews with waste management personnel [6–8]. However, the biggest problem

is that the waste is bulky, difficult to compress and is absorbing more and more space from already limited and overburdened municipal landfills [3].

Currently, various government institutions are working to change the residual standards of industries or bet on green buildings. Some authors [9] point out that companies are increasingly being given responsibility for sustainable development programmes such as sustainable production and consumption, climate change, energy or the protection of natural resources, among others. These studies [9] continue to indicate that although responsible business is a necessary condition for sustainable development, more action is needed to alleviate environmental damage, as many of the negative contributions to sustainable development derive from the behaviour of individual members of society. For this reason, social awareness has begun to be promoted from other contextual frameworks so that in the future improvements and modifications can be made to comply with European Union standards in relation to sustainable development [10].

As human actions are at the heart of environmental issues, sustainable development ultimately depends on changes in human behaviour. Thus, in recent decades, the promotion of environmentally friendly behaviour has increased through the media and the growing spectrum of formal and informal environmental education programmes [11]. However, the promotion of public participation and individual action remains a challenge for governments, organizations and institutions around the world [12,13]. For this reason, the United Nations General Assembly Resolution 57/254 of 20 December 2002 [14] promotes education for sustainable development by indicating that it is a fundamental tool for achieving environmental development goals by enhancing knowledge, values, competencies and skills that contribute to a just, economically viable and ecologically sustainable human future [15]. In addition, recent research has shown that pro-environmental behaviour is determined by a number of factors such as knowledge, attitudes, social norms, culture and infrastructure [16]. Along these lines, some studies [13,17] indicate that models of environmental behaviour change are based on providing information and education on the subject. For this reason, it is considered of special relevance in promoting an integral formation in environmental education in the teachers of the different educational levels, since they can become important agents to promote sustainability [18].

One of the sectors that supports these changes towards sustainability is the educational framework. As the UNECE report [18] points out, education can and must contribute to a new vision of global sustainable development. The purpose is to create a new model of thinking on environmental issues from the school framework. Thus, environmental training projects correspond to a large extent to a formal education focused on the achievement of a citizenship committed to sustainability. Several reports [15,19–21] have highlighted the need for a series of technological and educational measures in response to the fruitless work of political representatives in integrating the perspective of sustainable development at all levels of society. Specifically, the measures set out in these reports seek to make education an agent for change by involving all sectors, universities, teachers and students. In this way, curricular changes can be promoted or courses for teacher training can be promoted from teachers' centres, councils or universities [22].

Although the concept of sustainable development has been integrated into the educational curriculum of different countries as a compulsory learning subject [23,24], several studies indicate that school approaches should include a community environmental education programme to improve the knowledge, attitudes and behaviour of citizens in relation to this area [25,26]. Despite the fact that schools often have limitations in implementing such programs, education in science, technology, society and the environment (STSE) can promote literacy in the field of sustainability [27]. Specifically, it contributes to the acquisition of knowledge and concepts that can enable citizens to solve problems in the scientific-technological field and create positive and critical attitudes towards sustainable development [28–30].

Along the lines of these approaches, numerous studies on environmental education and education for sustainable development can be found. Thus, for example, some authors [31–33] have conducted studies on environmental education programmes, demonstrating that early childhood experiences

in nature provide children with cognitive and emotional benefits and influence the development of lifelong environmental attitudes and behaviours. However, other studies [34] state that children develop an understanding of ecological principles and human impact on the environment by being aware of environmental problems. However, they add that young people do not have the knowledge to alleviate this problem. In the case of Secondary Education, some studies [35] worked with a group of 15–16-year olds to incorporate and apply STSE knowledge to an uncontrolled dumping of waste in order to explain to the students the social and environmental repercussions it entailed. Conversely, some studies at a university level [36] analysed the perspective with which sustainability is approached in higher education degrees [37,38]. Specifically, these authors structured teaching-learning problems with a methodology approached through a SWOT analysis. Likewise, other works [39] analysed the environmental knowledge in the social graduates belonging to the field of sciences.

Several studies [33,40,41] suggest that environmental attitudes are formed in early childhood, roughly at the age of twelve. For this reason, the cognitive level of teachers in the STSE field, as well as the didactics applied to the teaching of students, is a very important factor to take into account. Specifically, this approach constitutes the research line of this study. Thus, the knowledge of teachers has a great influence on teaching practice and on the STSE literacy in our society [42–46]. However, the current conception of science hardly allows us to face the complexity of global environmental problems. The solutions to the global crisis that have found the greatest consensus recognize that environmental problems are not only problems of development, but basically problems of knowledge and education. Specifically, it is suggested that these problems in the educational framework go beyond mere learning, and that they also have to do with the way environmental problems are understood and addressed [22,47]. For this reason, education for sustainability should be a process of lifelong learning for citizens. Thus, society could be informed and involved, having a scientific and social culture so that it could have creative tools for solving problems based on responsible actions that guarantee a sustainable future [48]. Some authors [46] consider that learning about sustainable development has an adaptive function in today's world because it helps individuals to understand the increasingly complex context in which we live. Other studies [49] also point out that the beliefs of teachers are a very important factor if we want to contribute to changing the model of science teaching centred on the transmission of information, and to ensure that a high percentage of students find in science disciplines the necessary value to opt for them.

Focusing on the concept of waste in the framework of education, several studies have also been carried out. Some authors [50] have analysed the concept of waste in the education curriculum and the treatment given to this concept within the framework of sustainable development. Other studies [49] have evaluated the impact of a waste education programme on the school environment. On the other hand, other research [51] has analysed children's level of understanding of concepts related to waste and its environmental impact. These authors conclude in their study that there are cognitive deficiencies in this area on the part of schoolchildren since the sample selected did not relate the concepts of recycling or landfills with the production and management of waste.

For this reason, it is considered necessary for society to be aware of the existence of problems in the environment that are part of our daily lives. While some people appreciate the importance of nature, many others do not perceive its deterioration [50]. Therefore, education for sustainable development must be addressed to all within a perspective of continuous training, which captures all possible learning spaces, formal as well as non-formal and informal. In this way, a change of mentality in the teaching system can be promoted from the first school levels, in order to prepare most of the people who develop and manage the institutions of society and especially those who will act as teachers [48].

This paper analyzes the amount of knowledge presented by teachers in training at the secondary school stage about waste. For this purpose, a questionnaire composed of questions based on the secondary education curriculum (from 12 to 18 years old) has been used. It is necessary to highlight

the importance of teacher training in the field of waste and its management so that teachers in training can promote an education based on sustainability and sustainable development.

2. Materials and Methods

The design of the research carried out is of an exploratory type with mixed methods (qualitative and quantitative) and descriptive and inferential analysis of the data, in order to achieve the proposed objectives and provide a response to the hypotheses of the study.

2.1. Objectives

The general objective of this work has been to analyse the amount of knowledge of secondary school teachers in training on the subject of waste in the framework of sustainable development.

This general objective has been broken down into the following specific objectives:

- Specific Objective 1 (SO1): To elaborate and validate a knowledge test on waste. For this purpose, the categories obtained in the analysis of the Secondary Education curriculum regarding the concept of waste have been taken as a reference [50].
- Specific Objective 2 (SO2): To analyse the amount of knowledge of the future secondary school teacher on the concept of waste in each of the categories established in the measuring instrument on the basis of different variables such as gender or the scientific-technological area of the teachers.

2.2. Study Hypothesis

Based on the research objectives, the following hypotheses have been formulated:

Hypothesis 1 (H1): *Teachers in training in secondary education have a low amount of knowledge in the field of waste.*

Hypothesis 2 (H2): *The amount of knowledge of the secondary school teacher in training in the field of waste is different depending on the categories established.*

Hypothesis 3 (H3): *The level of confidence with which the secondary school teacher in training answers is different depending on the established categories.*

Hypothesis 4 (H4): *There are statistically significant differences in the amount of knowledge about waste among the teachers in training of the different academic areas.*

Hypothesis 5 (H5): *There are no statistically significant differences in the amount of knowledge about waste in relation to the gender variable.*

2.3. Sample

The sample participating in the study consisted of 72 teachers who were pursuing the Master's Degree in Secondary Education in different areas, specifically Technology, Physics/Chemistry and Biology/Geology. The sampling process carried out was non-probabilistic of convenience due to the ease of access to the sample. Table 1 shows a descriptive analysis of those surveyed.

As can be seen in Table 1, there are 47.3% men and 52.7% women, which means that there is gender parity in the sample. On the other hand, it is observed that most of the subjects are between 22 and 29 years old. On the other hand, it is shown how many participants belong to each area and from which degree they come.

Table 1. General data of the selected sample.

Variable		Frequency	Percentage
Gender	Men	34	47.3%
	Women	38	52.7%
Age	22–29	43	59.7%
	30–39	23	31.9%
	>9	6	8.4%
Area	Technology	29	40.2%
	Physics & Chemistry	18	25.1%
	Biology & Geology	25	34.7%
Degree	Bachelor's Degree in Biology and related fields	23	31.9%
	Bachelor's Degree in Physics and related fields	4	5.5%
	Bachelor's Degree in Chemistry and related fields	5	6.9%
	Architecture/Engineering and related fields	40	55.7%

2.4. Design of the Measuring Instrument

A previous study based on an analysis of the Compulsory Secondary Education (CSE) and Non-compulsory Secondary Education (Baccalaureate) curricula [52,53] in Spain on the concept of waste in the framework of sustainable development [50] was taken into consideration in order to elaborate the measuring instrument. The categories established in this study served as a reference for the proper design of the test to assess the amount of knowledge of teachers in training (the complete questionnaire can be found in Appendix A). The measuring instrument used was structured into the following categories:

- Category I (Items 1 to 6)—Waste and Society (WS): This category includes references to environmental or social problems in which the waste is linked.
- Category II (Items 7 to 12)—Regulations and Economy (RE): This category includes references related to waste regulations, as well as those affecting economic activities.
- Category III (Items 13 to 18)—Awareness (AW): This category includes references to the concept of waste from the perspective of ethics and awareness of the environmental problems that may arise.
- Category IV (Items 19 to 24)—Technological Development (TD): This category includes references that contribute to technological development or the achievement of the proper management of problems related to waste.
- Category V (Items 25 to 30)—Typology (TY): This category includes references related to the type and origin of the waste.

The selection of these categories has taken into account the legal regulations in relation to the level of educational importance of the concept of waste, and the social (in the categories WS and AW), economic (category RE) and environmental (categories TD and TY) factors.

The maximum score of the questionnaire was normalized to 100 points.

The main purpose has been to design a scale to assess the amount of knowledge of secondary school teachers in training, based on the concept of waste in the curriculum [50]. It consists of elaborating a series of items in each category that constitute a representative sample, as well as formulating the statements in a concise and clear manner for a correct understanding.

Specifically, six items have been formulated in each category that encompass the most important knowledge reflected in the regulations governing higher education curricula [52,53]. The items are distributed in a structured manner, that is, the first six items correspond to Category I, seven to twelve correspond to Category II, thirteen to eighteen fall into Category IV, and the rest fall into Category

V. Each item contains four possible answers that specify the concepts/knowledge to be detected in each case. In addition, each item contains a field where the subject is asked to assess the degree of certainty when answering (securely, doubtful or randomly). Once the elaboration of the measuring instrument has been completed, a detailed analysis of the questions formulated in the instrument is subsequently shown.

Category I (Waste and Society) is made up of items 1 to 6. Specifically, items 1, 2 and 6 deal with the importance of waste for our society. On the other hand, items 3, 4 and 5 deal with the social repercussion of waste generation in nuclear power plants. As an example, Figure 1 shows the statement of item 6 of this category.

6. Waste can be useful in our society to:
   a) Produce energy.
   b) In no case is waste useful in our society.
   c) Produce improvements in environmental quality.
   d) Produce improvements in air quality.
   * Securely, Doubtful or Randomly.

Figure 1. Example of a question in Category I (Waste and Society).

Secondly, the items referring to Category II (Regulations and Economy) have focused on the concept of inert waste (item 7), on the Spanish legislative framework (items 8, 11 and 12) and on the application of regulations to real situations (items 9 and 10). In Figure 2, an example question from this category is presented.

11. Is the management of radioactive waste included in the Waste and Contaminated Soil Act?
   a) No.
   b) Yes, it is included.
   c) Radioactive waste has its own specific regulations.
   d) Answers a) and c) are correct.
   * Securely, Doubtful or Randomly.

Figure 2. Example of a question in Category II (Regulations and Economy).

Items 13 to 18 form Category III (Awareness), and are based on reduction actions, waste recovery and concepts related to the 4Rs (items 13, 14, 16 and 17), social awareness (item 15) and the implementation of awareness campaigns (item 18). An example of this category is shown in Figure 3.

15. Social awareness in the field of waste has an influence on:
   a) Knowledge of recyclable waste.
   b) Environmental quality.
   c) The production process of the recyclable product.
   d) Answers a) and b) are correct.
   * Securely, Doubtful or Randomly.

Figure 3. Example of a question in Category III (Awareness).

Category IV (Technological Development) covers the concept of recovery (item 19), the location of the concept of reuse (item 20), the concept of calorific power of biomass during the burning process (item 21), the influence of the design process of a product for subsequent recycling (item 22), the application of the concept of pyrolysis applied to the field of waste (item 23) and influential factors in the introduction of recycled glass in its manufacturing process (item 24). As an example, item 22 of this category appears in Figure 4.

22. In the process of designing a product, the factors that will be taken into account so that the product can be reused are:
a) Material, shape and energy used.
b) Material and tools used in its design process.
c) Material and shape.
d) Material, shape and colour.
* Securely, Doubtful or Randomly.

Figure 4. Example of a question in Category IV (Technological Development).

Category V (Typology) includes the last six items of the questionnaire, items 25 to 30. Specifically, item 25 is intended for subjects to frame what types of waste belong to a type of domestic waste. Item 26 focuses on the elements that could be recycled depending on the type of waste they generate. Item 27 deals with the concept of MSW and item 28 with the concept of packaging. Finally, the concept of waste classification is dealt with in item 29 and the concept of CDW is dealt with in item 30. As an example, question 27 included in this category is shown in Figure 5.

27. Mark with a cross which statement(s) are correct:
a) A cardboard box of industrial origin can be disposed of in a blue container.
b) Any packaging can be disposed of in the yellow container.
c) Food leftovers are Urban Solid Waste.
d) All of the above are correct statements.
* Securely, Doubtful or Randomly.

Figure 5. Example of a question in Category V (Typology).

For the design of the multiple-choice questionnaire, the following general recommendations were taken into account:

- Of the thirty items designed, twenty-nine have only one correct answer and three incorrect ones called distractors, while one has multiple answers (it was a multiple-choice question where the respondent had to choose several items without any predetermined distractor).
- Among the three distractors, the "best distractor" (the most expected incorrect response by the population) was selected [54].
- The distractors have been developed based on the analysis of the concept of waste in the curriculum.
- A first draft test was prepared and submitted to eight researchers in the field of teaching of experimental sciences for validation.
- Based on the corrections made, the first test on waste concepts is prepared.
- The reliability and discriminatory power of the test are evaluated, and a statistical process is established.

2.5. Validation of the Evaluation Instrument: Calibration Indices

This section presents the psychometric analysis of the questionnaire taking as its main reference the guidelines recommended by other research [55,56]. These authors suggest several statistical tests focused on the evaluation of the questionnaire items (item difficulty index, item discrimination index, item point biserial coefficient and Ferguson's delta). Some authors [55,56] indicate that, if the parameters established in each case are met, it can be concluded that the test is reliable and has satisfactory discriminatory power. Table 2 presents the calculated indices and recommended values according to the literature [50,52].

Table 2. Psychometric analysis of the questionnaire developed.

Coefficient	Obtained Value	Recommended Value [55–57]
Mean Difficulty Index (P)	0.46	[0.30–0.90]
Mean Discrimination Index 1 (D1)	0.35	≥0.30
Mean Discrimination Index 2 (D2)	0.61	≥0.50
Mean point biserial coefficient (r_{pb})	0.22	≥0.20
Ferguson's delta (δ)	0.95	≥0.90

The difficulty index (P) measures the difficulty of a given item in a test. According to some studies [57,58], the range of values established for this index is between 0.3 and 0.9, 0.5 being the ideal value. These authors also suggest that, if the difficulty index of an item approaches 0, it will be difficult for that item to be adequately answered by the respondents, and if, on the contrary, the value approaches 1, the item is considered easy to answer. In the case of our questionnaire, we observe that the difficulty indices of the different items are within the established ranges, with the mean value of the test being 0.46, which indicates that the test as a whole presents an adequate conceptual difficulty for our research.

The discrimination index 1 (D1) assesses the discrimination power of each test item, that is, it allows us to distinguish between those respondents who answer correctly and those who have a less solid understanding and do not choose the correct answer in most cases. According to the literature [55,57] there is a proper discrimination when D1 $\geq$ 0.3. The average discrimination index of the test is 0.35, so it presents a value within the established range.

The discrimination index 2 (D2) indicates the proportion of right answers in the group of students with better grades with respect to the total number of subjects who respond correctly to the item. If the value of index D2 is 0.5 (ideal value according to [55]), it is accepted that more than half of the successful respondents belong to the group with the best percentage of right answers in the questionnaire. In our case, this fact is specifically fulfilled in more than 85% of the items and a mean value of 0.61 is obtained.

The point biserial coefficient (r_{pb}) measures the robustness of the item throughout the test and reflects the correlation between the respondents' scores on an item and the scores on the entire test. If an item is positively correlated with the entire test, it means that respondents with high scores are more likely to respond correctly than those with low scores. Literature [59] indicates that an item with good reliability will have a coefficient equal to or greater than 0.2.

Ferguson's delta (δ) measures the discriminatory power of the whole test, that is, it allows us to distinguish between students with more or less knowledge about waste. Ferguson [59] suggested that a normal distribution has a $\delta > 0.90$. On this basis, the questionnaire shows good discrimination since the value obtained for Ferguson's delta was 0.95.

3. Results

The results obtained have allowed us to assess different aspects of the current knowledge of the teacher in training in relation to waste and its impact on society.

The following sections will present the descriptive and inferential analysis of the variable amount of knowledge analysed in the sample under study. Likewise, the results on the degree of certainty in the response of the participants (Securely, Doubtful or Randomly) are detailed in order to contrast the results obtained in terms of amount of knowledge.

3.1. Test of Hypothesis 1: Students' Knowledge Regarding Waste

In order to test Hypothesis 1 (H1: Teachers in training in secondary education have a low amount of knowledge in the field of waste), a general evaluation of the data obtained in the test is shown. Table 3 presents the descriptive statistics mean, standard error of the mean and standard deviation of the percentage of correct answers on waste.

Table 3. Descriptive statistics of the percentage of correct answers on waste.

	Mean	Std. Error of the Mean	Std. Deviation
Percentage of correct answers	46.018	1.120	9.504

Table 3 shows that the results have not been entirely satisfactory due to the fact that the mean percentage reached in the questionnaire was 46.0%. This initially suggests that the concept of waste in the framework of sustainable development is not addressed thoroughly during the academic training of the teacher and this generates a lack of knowledge that may negatively affect future teaching activities.

Figure 6 shows the histogram with a superimposed normal distribution. It can be seen that, of all those surveyed, the majority of teachers in training had between 30% and 65% of correct answers. However, average scores are abundant in the centre of the graph, with the mean for the group being 46%, as mentioned above. It is also necessary to point out that there is a very small group of students with a low level of correct answers and, likewise, there is another small group that is answering correctly with a percentage close to 80%.

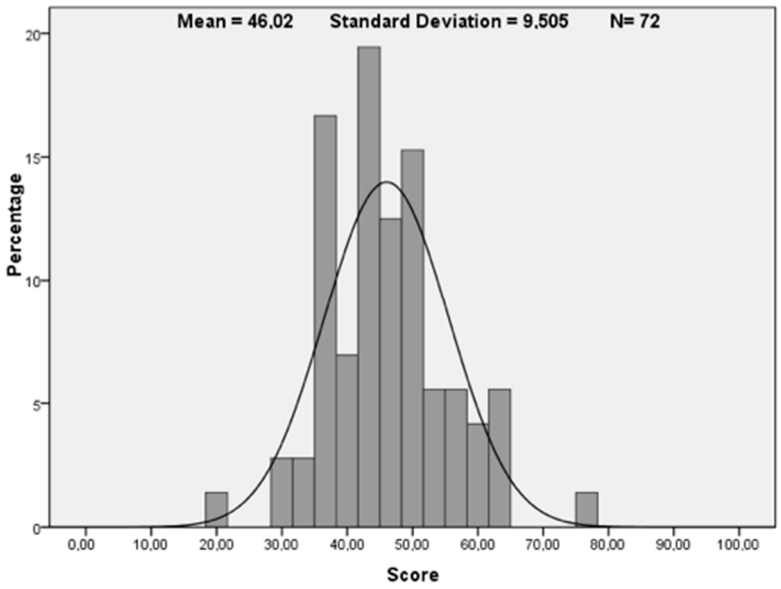

Figure 6. Histogram of the percentage of correct answers of the participants and superimposed normal distribution.

If the mean score obtained by each subject is analysed, it can be observed that only 16 of the 72 teachers surveyed respond correctly to more than 50% of the questions, which corresponds to 22.2% of the total sample.

The above results allow us to accept the H1 formulated in the research "Teachers in training in secondary education have a low amount of knowledge in the field of waste". A high percentage of teachers do not respond correctly to a large part of the questionnaire, which means that there are great cognitive deficiencies in the subject under study.

3.2. Test of Hypotheses 2 and 3: Students' Knowledge and their Confidence in their Answering within Individual Topic Regarding Waste

In order to test Hypothesis 2 (H2: The initial amount of knowledge of the future secondary school teacher in the field of waste is different depending on the categories established) and Hypothesis 3 (H3: The level of confidence with which the secondary school teacher in training answers is different depending on the established categories), Table 4 shows the mean scores obtained by the students,

differentiating each of the categories studied in the measuring instrument. The aim is to verify in which waste content there is a greater lack of knowledge.

Table 4. Mean score per category.

	Mean	Std. Error of the Mean	Std. Deviation
Waste and Society	6.8	0.3	2.2
Regulation and Economics	3.9	0.2	1.9
Awareness	5.6	0.2	1.9
Technological Development	3.1	0.2	1.7
Typology	3.8	0.2	1.6

Although the scores were not excessively high in general terms, the issues related to Waste and Society (Cat. I) and Awareness (Cat. III) were more accessible to students, as the score reached is above 5 points. On the other hand, Table 4 also reflects that teachers in scientific areas have not acquired solid learning on Regulation and Economics (Cat. II), Technological Development (Cat. IV) and Typology (Cat. V) since the average scores obtained are lower.

Figure 7 (left column) shows the percentages of correct answers in each of the items by category. Figure 7 (right column) shows the results in terms of the certainty with which respondents have answered the test (securely, doubtful or randomly).

Figure 7 (left column) confirms once again that worse results are obtained in the categories that imply technical knowledge about waste, such as Cat. II (Regulations and Economy) and Cat. IV (Technological Development). On the contrary, the students achieve better scores in the questions of Cat. I (Waste and Society) and Cat. III (Awareness). These data are related to the certainty percentages in the answers shown in Figure 7 (right column). It can be observed that a high percentage of teachers in training answer with confidence the items belonging to categories I and II. However, there are higher percentages of doubtful or random options in the questions referring to categories II and IV, considered more technical. With respect to Cat. V (Typology), it should be noted that there are questions with a high percentage of correct answers, as occurs in questions 25 and 28. However, there are also questions with a very low success rate, such as those found in questions 26, 29 or 30. The data are related to those found in the certainty percentages in the response in this category. Specifically, from Figure 7 (right column), it can be verified that the majority of students answered doubtfully (for example, item 26) or, alternatively, with certainty (for example, item 28). However, these results were as expected, since the questions corresponding to categories I and III are related to messages appearing in advertisements on the topics covered.

In order to statistically compare the results between categories, an inferential analysis has been carried out. Specifically, an ANOVA test has been carried out with a subsequent Tukey's Post-Hoc test to verify whether, statistically, there are better cognitive results in some categories compared to others.

The significance obtained in the ANOVA test was Sig. = 0.001. This reveals the existence of statistically significant differences in the mean scores obtained from the different categories. To check between which categories these significant differences appear, the results obtained in Tukey's Post-Hoc test are shown in Table 5.

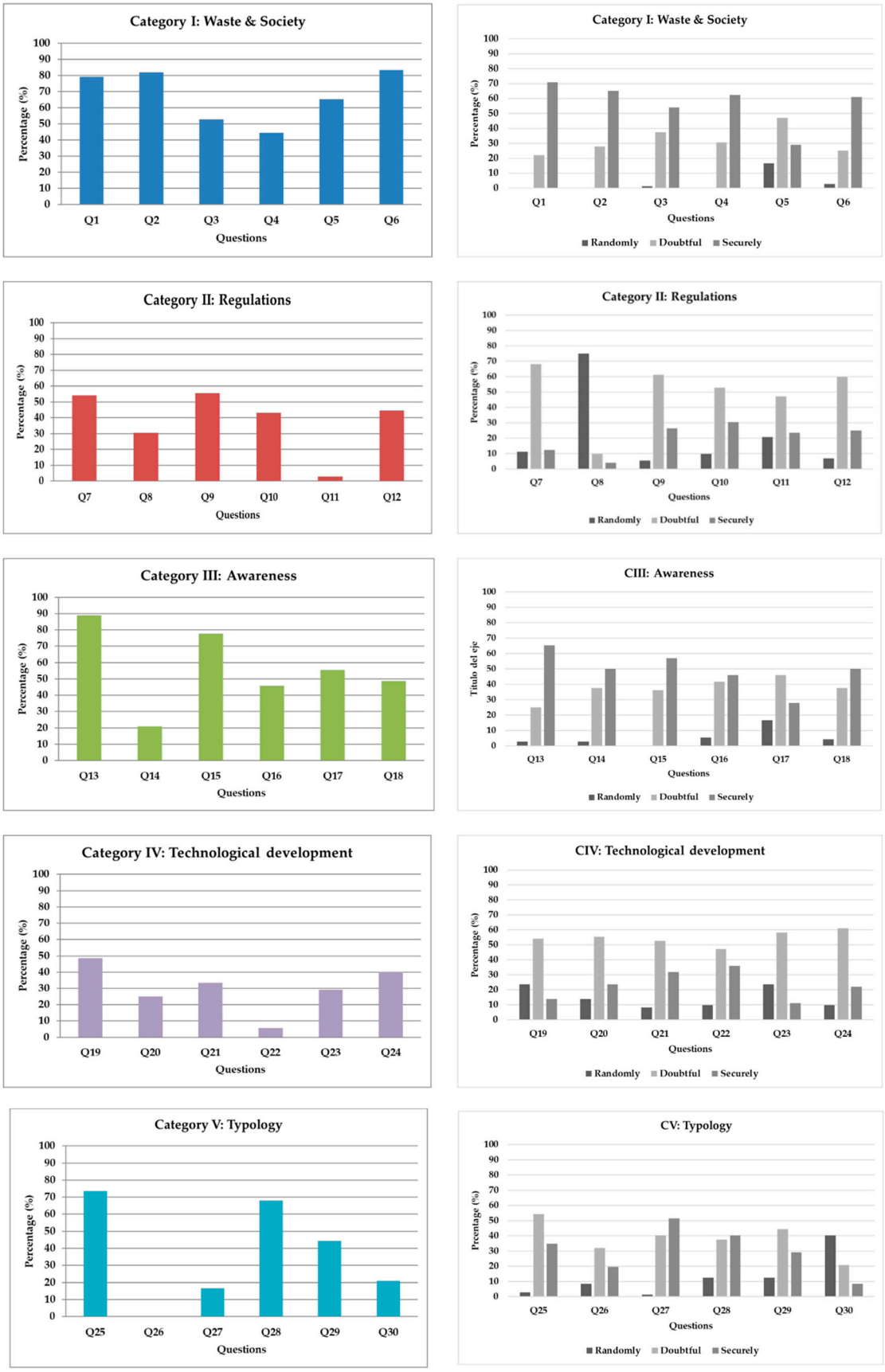

Figure 7. Analysis of the questions in each category. Percentage of correct answers (left column); percentage of certainty in the answer (right column).

Table 5. Tukey's Post-Hoc test in terms of categories.

(I) Category	(J) Category	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
I	II	0.384 *	0.031	0.000	0.198	0.371
	III	0.114 *	0.031	0.003	0.028	0.200
	IV	0.372 *	0.031	0.000	0.286	0.459
	V	0.301 *	0.031	0.000	0.215	0.387
II	III	−0.170 *	0.031	0.000	−0.256	−0.084
	IV	0.087 *	0.031	0.044	0.001	0.174
	V	0.016	0.031	0.985	−0.069	0.102
III	IV	0.258 *	0.031	0.000	0.172	0.344
	V	0.187 *	0.031	0.000	0.100	0.273
IV	V	−0.071	0.031	0.159	−0.157	0.015

* Sig. < 0.05.

There are statistically significant differences between most of the categories, but especially there are cognitive differences between Cat. I or Cat. III as opposed to the more technical categories such as Cat. II, Cat. IV and Cat. V. With this, it is verified again that in the questions of category I and III, better scores are obtained compared to the others, being easier to answer compared to the others. However, it is also observed that there are statistically significant differences between the categories considered more technical, as for example between Cat. II and Cat. IV, being the score favourable to Cat. II (Normative).

With the results specified in this section, hypothesis H2 can be accepted (The initial amount of knowledge of the future secondary school teacher in the field of waste is different depending on the categories established) and Hypothesis 3 (The level of confidence with which the secondary school teacher in training answers is different depending on the established categories). These hypotheses are accepted since the categories with the most technical items are the ones that obtain the worst results.

3.3. Test of Hypothesis 4: Amount of Knowledge by Academic Area

In order to test the H4 hypothesis (There are statistically significant differences in the amount of knowledge about waste among the teachers in training of the different academic areas), the descriptive statistics of the percentage of correct answers obtained according to the academic area variable are shown in Table 6.

Table 6. Descriptive statistics of the percentage of correct answers obtained according to the academic area variable.

	n	Mean	Std. Error of the Mean	Std. Deviation
Technology	29	47.1	1.7	9.3
Biology & Geology	25	42.3	1.8	9.1
Physics & Chemistry	18	49.4	2.1	9.0

The data shown in Table 6 reveal that future secondary school teachers in the area of Physics/Chemistry have more knowledge about waste in the framework of sustainable development, with a correct answer percentage of 49.4% compared to 47.1% and 42.3% of teachers in the areas of Technology and Biology/Geology, respectively.

Figure 8 provides detailed information on the average percentages obtained by the students of each academic area in each of the items of the questionnaire, in order to check which waste content the students of one area know better than those of the others.

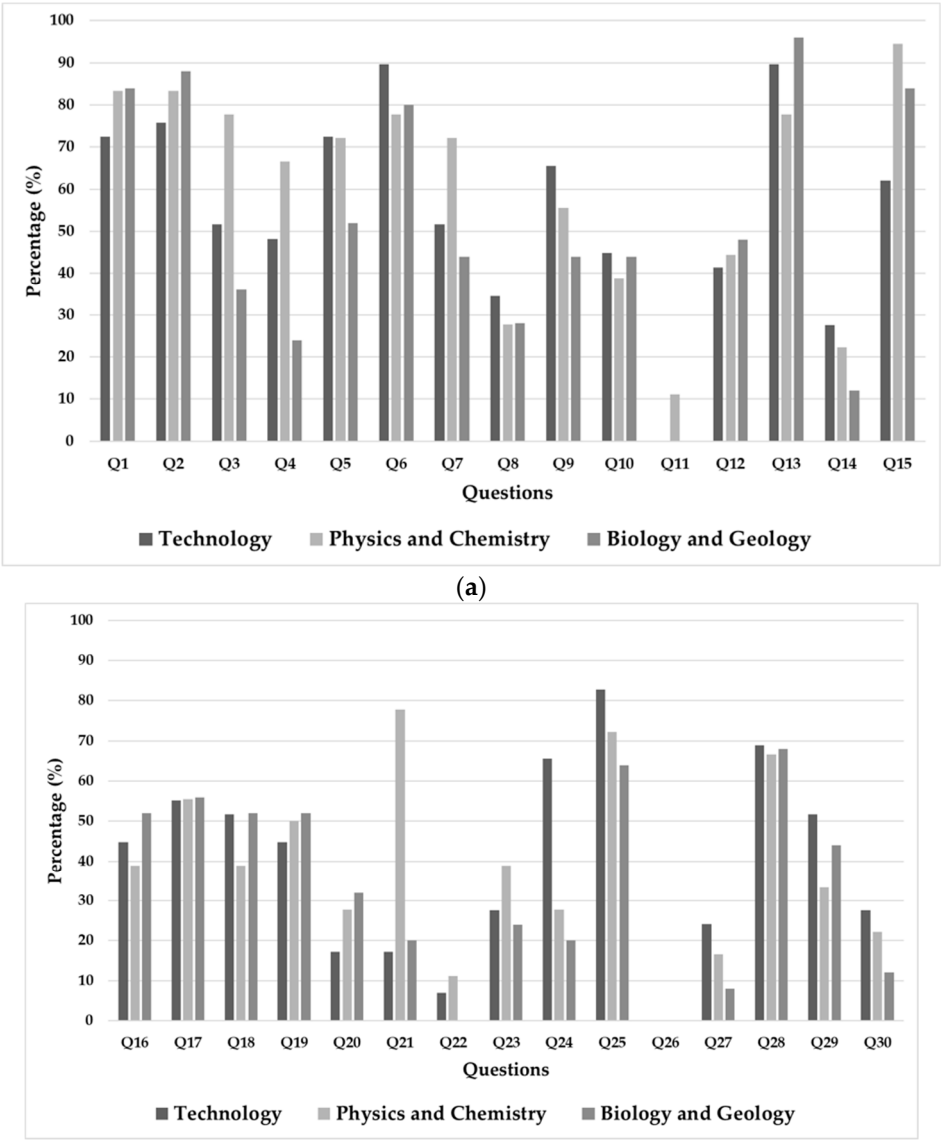

Figure 8. Comparison of the percentage of correct answers between academic areas. (**a**) Questions Q1–Q15; (**b**) Questions Q16–Q30.

Figure 8 shows a lack of knowledge on the subject that concerns us, since negative results are observed in many of the items. It can be observed that item 26 (in the typology category) has not been answered correctly by any of the respondents. Likewise, it can be observed that teachers in training in the area Technology have obtained better percentages of correct answers in twelve of the thirty items of the survey, specifically in items 5, 6, 8, 9, 10, 14, 24, 25, 27, 28, 29 and 30. In the area of Biology and Geology, the highest score was obtained in items 1, 2, 12, 13, 16, 17, 18, 19 and 20. With regard to Physics and Chemistry, it should be noted that the participants in this area scored higher on questions 3, 4, 7, 11, 15, 21, 22 and 23. If we analyse these results by categories, we find that students in the area Technology obtain the best scores in two of the three categories considered more technical or theoretical, specifically Regulation (items 7 to 12) and Typology (items 25 to 30). However, in Category IV (Technological Development), it is the Physics and Chemistry students who outperform the other two academic areas by obtaining the best score in three of the six items in the category (in fact, item 11 of the survey has only been satisfactorily answered by students in this area). In the rest of the categories, the highest scores of the items are distributed among the three areas.

Once the descriptive analysis was carried out, it was assessed whether there were statistically significant differences in the amount of knowledge of the students depending on the academic areas. In order to carry out the inferential analysis, it has been necessary to carry out a prior statistical evaluation to check whether the requirements for opting for parametric tests are met. Once the test of normality, randomness of the sample and homoscedasticity was carried out, it was verified that the requirements to use parametric tests were met when obtaining a Sig. > 0.05 in all cases. Table 7 shows the results obtained in the tests of normality and randomness of the sample.

Table 7. Normality and randomness tests.

	Normality (Kolmogorov-Smirnov)	Randomness
Technology	0.200 *	0.480 *
Biology & Geology	0.154 *	0.650 *
Physics & Chemistry	0.061 *	1.000 *

* Sig. > 0.05.

Table 8 show whether there are statistically significant differences between the students of the different areas in terms of amount of knowledge, taking as a reference the ANOVA with Post-hoc Tukey HSD test. Specifically, Table 8 presents the ANOVA test of the percentage of correct answers depending on the academic area variable, with the purpose of determining if there are statistically significant differences.

Table 8. ANOVA test of the percentage of correct answers (academic area variable).

		Sum of Squares	df	Mean of Squares	F	Sig.
Percentage of correct answers	Between groups	598.772	2	299.386	3.552	0.034 *
	Within groups	5815.425	69	84.282		
	Total	6414.198	71			

* Sig. < 0.05.

The value of Sig. = 0.034 reveals the existence of statistically significant differences between the different areas. However, in order to analyse which areas have such differences, an analysis was carried out with a Tukey's Post-Hoc test. The results of this test only showed statistically significant differences between the areas of Biology & Geology versus Physics & Chemistry (Sig. = 0.036), in favour of the latter area. On this basis, Hypothesis 4 (There are statistically significant differences in the amount of knowledge about waste among the teachers in training of the different academic areas) is partially accepted. Table 9 shows the ANOVA performed for each of the questions, with the purpose of knowing which categories the differences found are most pronounced. Table 9 only represents items 3, 4, 11, 15, 21 and 24, the questions that have obtained a significantly less than the reference value (Sig. < 0.05).

Table 9. ANOVA of the questions (academic area variable).

		Sum of Squares	df	Mean of Squares	F	Sig.
Q3	Between groups	1.832	2	0.916	3.923	0.024 *
	Within groups	16.112	69	0.234		
	Total	17.944	71			
Q4	Between groups	1.976	2	0.988	4.315	0.017 *
	Within groups	15.801	69	0.229		
	Total	17.778	71			
Q11	Between groups	0.167	2	0.083	3.234	0.045 *
	Within groups	1.778	69	0.026		
	Total	1.944	71			
Q15	Between groups	1.312	2	0.656	4.067	0.021 *
	Within groups	11.132	69	0.161		
	Total	12.444	71			
Q21	Between groups	4.751	2	2.375	14.571	0.000 *
	Within groups	11.249	69	0.163		
	Total	16.000	71			
Q24	Between groups	3.157	2	1.578	7.689	0.001 *
	Within groups	14.163	69	0.205		
	Total	17.319	71			

* Sig. < 0.05.

The Turkey's Post-Hoc statistical test was carried out to check exactly between which groups the significant differences previously found exist. These results appear in Table 10 below.

Table 10. Tukey's Post-Hoc test (academic area variable).

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Q3	B & G	P & C	−0.417 *	0.149	0.018 *	−0.775	−0.060
Q4	B & G	P & C	−0.426 *	0.147	0.014 *	−0.781	−0.072
Q15	T	P & C	−0.323 *	0.120	0.024 *	−0.6124	−0.0351
Q21	T	P & C	−0.605 *	0.121	0.000 *	−0.8956	−0.3152
	B & G	P & C	−0.577 *	0.124	0.000 *	−0.8767	−0.2788
Q24	T	B & G	0.455 *	0.123	0.001 *	0.1590	0.7513
	T	P & C	0.377 *	0.135	0.019 *	0.0518	0.7030

* Sig. < 0.05.

Table 10 reveals the existence of statistically significant differences (Sig. < 0.05) between Biology and Geology and Physics and Chemistry in items 3, 4 and 21, between Technology and Physics and Chemistry in items 15, 21 and 24 and between Technology and Biology and Geology in item 24. Therefore, H4 (There are statistically significant differences in the amount of knowledge about waste among the teachers in training of the different academic areas) is partially accepted.

3.4. Test of Hypothesis 5: Gender Variable

Table 11 shows the descriptive statistics of the percentage of correct answers obtained according to the gender variable, noting that 38 of the total sample are women and 34 men.

Table 11. Descriptive statistics of the sample (gender variable).

	Gender	n	Mean	Standard Deviation	Mean Std. Error
Percentage of correct answers	Women	38	45.8	9.6	1.6
	Men	34	46.3	9.5	1.6

Table 11 shows that the percentage of correct answers for women was 45.8 and for men 46.3. A difference of 0.5 points can be seen in the mean in favour of men. However, in order to verify that this difference is statistically significant, an inferential analysis of the data has been carried out using a Student's t-test for independent samples, the results of which are shown in Table 12. It should be noted that this statistical test has been chosen because the necessary criteria for its selection are met.

Table 12. Student's t-test (gender variable).

	Levene's Test for Equality of Variances		*t*-Test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Lower
Percentage of correct answers	0.076	0.783	−0.215	70	0.831	−0.485	2.258	−4.9905	4.020

The results show that there are no statistically significant cognitive differences between genders since a Sig. > 0.05 was obtained in the inferential analysis of the percentage of correct answers. Based on these results, hypothesis 5 is accepted (There are no statistically significant differences in the amount of knowledge about waste in relation to the gender variable).

4. Discussion and Conclusions

The results presented in the previous section are intended to show the amount of knowledge about the concept of waste among future secondary school teachers. The analysis carried out by categories helps us to define, with a certain future perspective, the most urgent lines of action and intervention on some of the key concepts for education in sustainability. In order to highlight a summary of the results obtained, Table 13 specifies the acceptation or rejection of the hypotheses considered in this study.

Table 13. Summary of the hypotheses examined.

Hypothesis	Accepted	Rejected
Hypothesis 1 (H1): Teachers in training in secondary education have a low amount of knowledge in the field of waste.	X	
Hypothesis 2 (H2): The initial amount of knowledge of the future secondary school teacher in the field of waste is different depending on the categories established.	X	
Hypothesis 3 (H3): The level of confidence with which the secondary school teacher in training answers is different depending on the established categories.	X	
Hypothesis 4 (H4): There are statistically significant differences in the amount of knowledge about waste among the teachers in training of the different academic areas.	Partially	
Hypothesis 5 (H5): There are no statistically significant differences in the amount of knowledge about waste in relation to the gender variable.	X	

As can be seen in Table 13, four of the five hypotheses initially proposed are accepted, while H4 is partially accepted.

The data analysed reveal a lack of knowledge by the teacher in training about waste in the framework of sustainable development, especially in legislative or purely theoretical aspects corresponding to categories II (Regulations), IV (Technological Development) and V (Typology). However, students show a higher amount of knowledge in categories I (Waste and Society) and III (Awareness). These results may be due to the fact that the contents of categories I and III are more

general topics on the subject of waste that are covered on a daily basis in awareness campaigns carried out by the media or various institutions. On the contrary, the items of the rest of the categories include more technical and theoretical concepts and therefore were more difficult to remember by the participating subjects, even though they have been studied during their formative stage, and regulated by the education curriculum, as was seen in the analysis of the curriculum carried out [50]. In this line, it can be mentioned curricular subjects such as Physics and Chemistry in second and third year of CSE or core subjects offered by educational centres such as *Technology* in third year of CSE or Sciences Applied to Professional Activity and Scientific Culture in fourth year of CSE. In the case of the Baccalaureate, we do not find any core subject that addresses the concept of waste from the point of view of sustainability, but there are optional subjects such as Economics, Industrial Technology I and II or Earth and Environmental Sciences, in which these contents are developed. In this sense, some authors [42,43,45] suggest taking into account the didactics used during the teaching-learning process in order to ensure an adequate amount of knowledge in teachers in training, because it will depend on them that future generations acquire an adequate STSE literacy.

The results were subsequently contrasted through the analysis carried out on the level of certainty in the response, verifying that the participants show greater certainty when it comes to answering the questions belonging to these categories more related to the social spheres. Due to the above, we can conclude the acceptance of H1, H2 and H3.

On the other hand, statistically significant differences have been found in the amount of knowledge about waste depending on the academic area variable. However, as this differentiation has only been found in some of the questionnaire questions, hypothesis 4 is partially accepted.

With respect to the analysis based on the gender variable, there are numerous gender stereotypes that indicate that the cognitive level of women in scientific and technological areas is lower than that of men [60] and that women are noted for their psychological and social skills [61]. Other studies focused on this topic support the fact that girls choose fields related to services and boys prefer studies related to industry and electronics [62]. In contrast, there is research stating that environmental attitudes are significantly more positive in women than in men [63]. Specifically, some studies [64] indicate that women engage more frequently in pro-environmental behaviors than men, and other authors [65] point out that women show more concern than men about local environmental problems that pose significant risks to the health and safety of community members. Historically, science and technology have been considered a male-dominated field, and women's contributions and knowledge have been overlooked [66]. In addition, several studies affirm that the representation of women has been smaller or less visible in comparison to the image of men as a reference of the scientific, political, economic, social and cultural aspects in relation to the generation and acquisition of knowledge [67]. However, in this study, H5 is accepted on concluding that there are no statistically significant differences at the cognitive or conceptual level on the subject of waste, thus reaffirming other studies carried out [68].

Based on the results obtained in the hypothesis testing, it can be concluded that there is little attention in the educational field to the concept of waste from the point of view of sustainability, as some authors [50] point out in the analysis of the education curriculum carried out. Understanding the nature and dynamics of transformation processes towards sustainability requires interdisciplinary knowledge and a deep commitment to sustainability values [69]. Citizens need to have certain key competencies that enable them to engage constructively and responsibly with today's world [19]. The concept of sustainable development emphasizes educational methods of innovation and research; therefore, schools should include methods of solving environmental problems more intensively and relate environmental improvement and sustainability to reality and everyday problems [51]. The lack of knowledge in the group of teachers in secondary education training in scientific-technological areas is surprising. Specifically, in a subject as contemporary as the generation of waste and its recycling, mainly because we live in a society in which science and technology play a crucial role in daily life [70]. There is a need to reorient or expand the role of universities in teaching sustainable knowledge to students in order to contribute more explicitly to the environmental needs and challenges of

society [19]. This educational change would enable teachers in training to acquire the skills to develop pro-environmental behaviour through a solid knowledge base and a positive attitude towards the environment [51]. Because today's students will face environmental issues and make decisions about development and sustainability in the future, it is imperative to analyse this knowledge in formal teaching in science classrooms [71]. sAlthough the full integration of the concept of sustainability into curricula remains one of the main priorities today, it is unquestionable that in order to facilitate a change in the behaviour of these students and increase their awareness, environmental education should be an integral part of the curriculum throughout compulsory education [72]. Likewise, the extension of this discipline to the curricula of university students is fundamental to improve sustainability and the production of less waste. [19,73].

As a result, students should participate in a learning process that helps them to improve their knowledge of waste management and to take action in favour of the environment [72]. This is consistent with some studies [10] which indicate that children and young people generally have limited knowledge about the environment and nature, and many of them have an incomplete or completely erroneous understanding. As some authors [74,75] pointed out, the environmental attitudes of young people are considered crucial for environmental education as they ultimately play a direct role in providing solutions to environmental problems in the not too distant future.

The first step towards improving the sustainability of a waste management system is to understand the characteristics of solid waste and the existing legal channels on the subject [76]. Public institutions, schools and service organizations should make a concerted effort to provide positive models of environmental behaviour by working on the contents of the curriculum as it has been verified that, thanks to didactic interventions on solid waste reduction or recycling programmes, people make appropriate decisions on waste management, recycling and the frequency of doing so [77].

We agree with [78] that school and environmental programmes aimed at students improve the environmental knowledge, attitudes and behaviours not only of the students themselves but also of adults (parents, teachers and members of the local community) thanks to the process of intergenerational influence. In other words, students should discuss with their parents or other adults their experiences in environmental education programs, their understanding of and attitudes toward environmental issues, and their desire to take action on environmental concerns [79]. Specifically, and in relation to the issue of intergenerational influence, the studies of [80] show very promising results in the resolution of local environmental problems thanks to the joint work of children, adults and schools. The process of intergenerational influence has important implications for educators who wish to promote discussion and action on the environment beyond the boundaries of the classroom [81]. By involving parents in the discussion of environmental issues, they can assume a more active role in their children's environmental education, thus contributing to the development of long-term environmental awareness and concern [10,82].

In view of the above, it is concluded that curricular proposals for scientific literacy related to sustainable development should be taken into account [22]. However, education for sustainability should be included in a greater number of disciplinary areas and at all levels of education so that society develops interdisciplinary and systemic knowledge of both the natural and the built environment, as well as the skills necessary to be able to participate actively in the development of a sustainable society and economy [48]. The purpose of incorporating the principles, knowledge, skills, perspectives and values related to sustainability in university educational programs is to enable students to make responsible decisions and achieve changes in behaviour towards a more sustainable and just society for all. The diversity of experiences included in the programs of various pro-environmental institutions can be used for sustainable learning at different educational stages through joint participation in activities of education, research or dissemination of sustainability in science areas [69].

Education for sustainability is a slow, long-term process that requires broad education and the willingness of people trained in the field. It is therefore necessary to empower competencies in sustainability from all educational levels, including specific programs in the training of future teachers.

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Appendix A. Complete Questionnaire

BLOCK 1—WASTE AND SOCIETY

1. The influence that waste has on our society has repercussions:

a) On our way of life.
b) On the appearance of new materials (basically plastics).
c) On economic growth.
d) All of the above are correct.

* Securely, Doubtful or Randomly.

2. One of the ways in which waste can have an impact on the economy of a given region would be:

a) The emergence of companies oriented towards waste management.
b) To reduce the payment of the waste treatment fee on the basis of the % recycled per subscriber to the waste collection service.
c) The two above are correct.
d) Waste does not have any impact on our society, which is why it does not influence its economy.

* Securely, Doubtful or Randomly.

3. The following picture shows:

Figure A1. Question 3. Source: https://www.flickr.com/photos/rodrigomezs/10562142755.

a) A nuclear power plant releasing polluting gas into the atmosphere.
b) A nuclear power plant releasing non-polluting gas into the atmosphere.
c) A nuclear power plant releasing polluting and non-polluting gases into the atmosphere.
d) A fire at a nuclear power plant.

* Securely, Doubtful or Randomly.

4. With reference to the above picture, do you think these gases influence the air quality of people living near a nuclear power plant?

a) Yes, always.
b) No.

c) They are only dangerous for the quality of the air when the central is in load.
d) Yes, but only if the emitted gases have the color of those that appear in the picture.

* Securely, Doubtful or Randomly.

5. In Extremadura, the production of radioactive waste, with respect to the Autonomous Community of Madrid is:

a) Null.
b) Very low.
c) High.
d) Madrid has a generation of radioactive waste much higher than Extremadura.

* Securely, Doubtful or Randomly.

6. Waste can be useful in our society to:

a) Produce energy.
b) In no case is waste useful in our society.
c) Produce improvements in environmental quality.
d) Produce improvements in air quality.

* Securely, Doubtful or Randomly.

BLOCK 2—REGULATIONS AND ECONOMY

7. What is inert waste? Choose the right statement:

a) It is that hazardous waste, which undergoes significant physical, chemical or biological transformations, is not soluble or combustible, does not react physically or chemically, is not biodegradable and does not negatively affect other substances in which it comes into contact.
b) It is that hazardous or non-hazardous waste, which undergoes significant physical, chemical or biological transformations, is not soluble or combustible, does not react physically or chemically, is not biodegradable and does not negatively affect other substances in which it comes into contact.
c) It is that non-hazardous waste that does not undergo significant physical, chemical or biological transformations, is not soluble or combustible, does not react physically or chemically, is not biodegradable and does not negatively affect other substances in which it comes into contact.
d) None of the above, as there is no such thing as inert waste.

* Securely, Doubtful or Randomly.

8. In Spain, the Waste Act to be applied is:

a) Act 22/2011.
b) Act 22/2012.
c) Act 23/2011.
d) Act 25/2011.

* Securely, Doubtful or Randomly.

9. The Sánchez García family live in the centre of Madrid and want to change their refrigerator by discarding the one they have. According to the regulations we could say that the discarded refrigerator is:

a) An inert waste.
b) A hazardous waste.
c) A radioactive waste.
d) Not considered a waste.

* Securely, Doubtful or Randomly.

10. Antonio's car has 40,000 km and needs a change of tires. He decides to buy them and change them at home. Who is required to collect the worn ones?

a) Any retailer who sells tires.
b) The retailer where he bought the new tires.
c) No one is required to collect them.
d) Any repair shop.

* Securely, Doubtful or Randomly.

11. Is the management of radioactive waste included in the Waste and Contaminated Soil Act?

a) No.
b) Yes, it is included.
c) Radioactive waste has its own specific regulations.
d) Answers a) and c) are correct.

* Securely, Doubtful or Randomly.

12. According to the Law on Waste in Spain, could we consider a battery as household waste?

a) Yes.
b) No, since it is considered hazardous waste.
c) No, since it is considered toxic waste.
d) No, since it is considered inert waste.

* Securely, Doubtful or Randomly.

BLOCK 3—AWARENESS

13. Among the actions to reduce the production of waste are the 4Rs, which are:

a) Reduce, Reuse, Recycle and Recover.
b) Revalue, Reject, Retake and Recycle.
c) Reduce, Repeat, Recycle, and Retake.
d) There is no such thing as the 4Rs.

* Securely, Doubtful or Randomly.

14. Both reduction and recovery, as actions to reduce waste, preserve:

a) The useful life of the product.
b) Natural resources.
c) The productive process of the product.
d) Answers a) and b) are correct.

* Securely, Doubtful or Randomly.

15. Social awareness in the field of waste has an influence on:

a) Knowledge of recyclable waste.
b) Environmental quality.
c) The production process of the recyclable product.
d) Answers a) and b) are correct.

* Securely, Doubtful or Randomly.

16. The term Reduce means:

a) To avoid the purchase of products that are not necessary and that in a short period of time will be a waste.
b) Make a selective selection of the waste generated by ourselves.
c) Give a second use to those products that no longer serve their original purpose.
d) All of the above answers refer to the term Reduce.

* Securely, Doubtful or Randomly.

17. Recovery is related to:

a) Industrial processes.
b) Household consumption.
c) Livestock consumption.
d) Livestock and household consumption.

* Securely, Doubtful or Randomly.

18. Juan is 20 years old, and after all the awareness-raising campaigns, both in print and broadcast media, he knows that the waste depicted in the picture can be disposed of:

Figure A2. Question 18. Source: https://pixabay.com/es/pinturas-tintas-verde-gris-bote-1342452/.

a) In the green container.
b) In the blue container.
c) In the yellow container.
d) The waste depicted in the picture cannot be disposed of in any of the above three containers.

* Securely, Doubtful or Randomly.

BLOCK 4—TECHNOLOGICAL DEVELOPMENT

19. Indicate which of the following statements is correct:

a) The valorization of waste is an activity guaranteed by the European Union.
b) Waste valorization is an activity that takes place after recycling and before final elimination.
c) The two previous answers are correct.
d) The valorization of waste is an activity guaranteed by the Spanish Government and the Autonomous Communities.

* Securely, Doubtful or Randomly.

20. The reuse of a product depends largely on:

a) The design process.
b) The regulations established in the Law on the recovery of products.
c) The toxicity of the product.
d) None of the above.

* Securely, Doubtful or Randomly.

21. We have 1kg of paulownia wood pellets, then they are ignited and burned. Indicate when you think they have more energy:

a) When the fire is off.
b) When the fire starts to ignite.
c) In the middle, when the fire burns with a great flame.
d) In all cases they have the same energy.

* Securely, Doubtful or Randomly.

22. In the process of designing a product, the factors that will be taken into account so that the product can be reused are:

a) Material, shape and energy used.
b) Material and tools used in its design process.
c) Material and shape.
d) Material, shape and colour.

* Securely, Doubtful or Randomly.

23. Pyrolysis could be:

a) A process of recovery of plastics and metals.
b) A process of rejection of plastics and metals.
c) A process of recycling plastics and metals.
d) All of the above are correct.

* Securely, Doubtful or Randomly.

24. During the glass manufacturing process, one of the important factors when introducing recycled glass would be:

a) The colour of the recycled glass to be introduced as a raw material in the production proces.
b) The size of the recycled glass to be introduced as a raw material in the production process.
c) The shape of the recycled glass to be introduced as a raw material in the production process.
d) All of the above are correct.

* Securely, Doubtful or Randomly.

BLOCK 5—TYPOLOGY

25. Fluorescent lights and refrigerators, at the end of their useful life:

a) Are considered hazardous waste.
b) The refrigerator is a hazardous waste, but the fluorescent light is not.
c) The refrigerator is not a hazardous waste, but the fluorescent light is.
d) Under no circumstances are refrigerators and fluorescent lights hazardous waste.

* Securely, Doubtful or Randomly.

26. Among the items listed below, identify those that you think could be recycled after their useful life has ended:

a) A pencil
b) A TV set
c) A washing machine
d) A book
e) A calculator
f) A can opener
g) A winding watch
h) A table
i) A gas heater
j) An hourglass
k) A candle
l) A weather vane
m) A tree

* Securely, Doubtful or Randomly.

27. Mark with a cross which statement(s) are correct:

a) A cardboard box of industrial origin can be disposed of in a blue container.
b) Any packaging can be disposed of in the yellow container.
c) Food leftovers are Urban Solid Waste.
d) All of the above are correct statements.

* Securely, Doubtful or Randomly.

28. A. We finished a milk carton after breakfast / B. We broke a plastic box, which was full of fruit. Can both elements be disposed of in the yellow container?

a) Only A is recyclable and can be disposed of in the yellow container.
b) Only B is recyclable and can be disposed of in the yellow container.
c) In both cases A and B are recyclable, but only A can be disposed of in the yellow container.
d) None of the elements can be disposed of in the yellow container.

* Securely, Doubtful or Randomly.

29. Due to their hazardous nature, waste is classified as:

a) Toxic, very toxic and neutral.
b) Neutral and toxic.
c) Inert, toxic and radioactive.
d) Neutral, toxic and radioactive.

* Securely, Doubtful or Randomly.

30. What kind of waste are CDWs?

a) Neutral.
b) Inert.
c) Radiactive.
d) Toxic.

* Securely, Doubtful or Randomly.

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