Environmental Literacy in Initial Teacher Training: Pre-Service Teachers’ Perceptions of the Socio-Environmental Impact of Food

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Abstract: This qualitative descriptive-interpretive study aims to understand and describe the perceptions of a group of pre-service teachers of the degree of environmental literacy in primary education at the University of Seville. They participated in a training proposal focused on the current eco-social crisis related to the socio-environmental impact of food in which the different dimensions constituting environmental literacy were analysed. Those dimensions are knowledge, attitudes and emotions, behaviour, and the didactic knowledge associated with socio-environmental issues. The students’ diaries were used as a data-collecting tool in this study. The results reveal a heterogeneous distribution in the students’ understanding and internalisation of concepts related to the dimensions of environmental literacy. In terms of knowledge, most students show a deep and holistic understanding. Diversity is observed in their attitudes and emotions towards socio-environmental issues, and tentative attitudes towards change prevail. Finally, their intentions and proposals for solutions mainly reflect simplistic perceptions. This emphasises the importance of encouraging active participation and collaboration in the search for socio-environmental solutions. In general, the results stress the need to continue improving the preparation of future teachers with regard to environmental education. A deeper understanding and a committed attitude towards sustainability and the preservation of the social and natural environment should be encouraged in initial teacher training.

Keywords: environmental literacy; initial teacher training; socio-environmental issues

1. Introduction

We currently find ourselves immersed in a profound socio-environmental crisis that threatens the stability of our planet. This crisis manifests itself in a series of interrelated challenges that affect both the environment and society as a whole. From climate change to biodiversity loss, including environmental pollution, and overexploitation of natural resources, the warning signs are increasingly evident. The IPCC [1] reports, together with other reports, consider human activity as the main factor driving the ramifications of climate change, clearly visible in the increase in global temperature, the decrease in water security, episodes of extreme heat, or the reduction of food security.

As Göpel [4] explains, the current planetary emergency should motivate us to look for alternative solutions to move towards sustainable societies.

In this context, education plays a key role, and the need for close collaboration between universities, schools, and society to give rise to a new orientation in research, academic training, and knowledge transfer is clear [5]. Education and training enable students to develop competencies and acquire knowledge, skills, and attitudes that are essential to
appreciating our environment and carrying out actions to preserve it [6], thus contributing to facilitating the transition towards a more equitable and environmentally friendly society.

Environmental education (EE) is about understanding socio-environmental issues. It requires the participation of all educators, regardless of their area and level of work, as expressed by the United Nations in establishing the Decade of Education for a Sustainable Future. We must be aware of the close relationship between education for a sustainable future and quality EE [7].

In this regard, EE recognises the importance of people acquiring the ability to discover the causes, consequences, and possible solutions related to the socio-environmental crisis [8]. Pro-environmental and sustainable behaviour, which constitutes the basis for citizens to be committed to the natural environment [9], should be promoted. The Value-Belief-Norm (VBN) theory suggests that pro-environmental actions do not arise simply from a general awareness of environmental issues but from a process in which a person’s values and beliefs influence their personal norms, which in turn drive specific behaviours [10]. This approach is relevant to justify studies focusing on environmental education and teacher training, as it highlights the need to instil pro-environmental values and beliefs in educators. They can thus promote sustainable norms and behaviours in their students.

It is necessary to train people in the use of skills that encourage reflection on their individual actions, considering their impact in different areas [11]. Universities, in charge of preparing future professionals and teachers, should adapt to the emerging demands of society, performing their role from a sustainable perspective [12].

Several researchers advocate for the incorporation of environmental topics in initial teacher training, arguing that responsible, committed, and well-prepared teachers are crucial [12,13]. Training teachers in those topics is vital as it would provide them with the necessary knowledge, skills, and competencies to improve their teaching about the environment [14].

Teachers are responsible for educating future generations to address the challenges associated with the current unsustainable development [11]. They also play a key role in shaping the future [15]. This requires interdisciplinary collaboration, and teachers need to have a complete understanding of the global context [16].

In this scenario, promoting environmental literacy (EL) among teachers is of crucial importance [17] since it contributes to understanding the current state of the environment, evaluating the risk for the preservation of life, and acquiring skills and attitudes that promote democratic, equitable, and resilient social structures [18].

The definition and implementation of EL vary depending on the interpretations of each researcher and are closely linked to the elements that make up this concept, which serve as the basis for its evaluation [19]. The first researchers to define EL were Roth [18], Stables and Bishop [20] and Tuncer et al. [21]. In their view, environmentally literate people possess interrelated competencies and the ability to make connections between humans and the biosphere. They are also able to reflect on the consequences of these interrelationships and have an awareness that respects the limits of the planet. Authors such as Alvarez-García et al. [22] and the NAAEE [23] define EL as the awareness of and concern for the natural environment and associated problems, in addition to acquiring the necessary knowledge, skills, and motivations to address and resolve present and future environmental challenges, which is the primary objective of EE.

From the analysis of the literature on EL, three critical elements are identified that should be considered in the process: knowledge, attitudes, and environmental behaviour [18,20–22,24–27].

According to Pe’er’s research [28], there is a close connection between environmental knowledge and attitudes towards the environment. This implies that continuous education programmes designed to improve teachers’ EL can influence the development of their own attitudes towards the environment.

With respect to education, and more particularly initial teacher training, the main focus of this research, it is worth stressing the importance of knowing the level of EL of pre-service
teachers. Studies conducted by Álvarez-García [24], Pe’er et al. [28], Goldman et al. [29] and Yavetz et al. [30] reveal that the EL level of pre-service teachers is remarkably low, although it is not uniform in all its aspects.

The current study was carried out within this context. It aims to know and interpret a group of pre-service teachers’ perceptions of EL. They participated in a training proposal focused on the socio-environmental impact of food.

Based on the ideas outlined above, human beings have the ability to make decisions in various aspects of life. This enables them to make changes in their environment and reduce the environmental impact of their eating habits [31]. The impact of climate change on food is clear and affects the entire world population, without exceptions.

Brocos and Aleixandre [32] explain that food is perceived by citizens and students mainly in terms of health and nutrition. They do not recognise the environmental impact associated with different diets. Food is part of a global system that produces, transforms, preserves, packages and transports food to our homes. This causes greenhouse gas emissions [33], turning food into the human activity that has the greatest impact.

2. Materials and Methods

This study is an in-depth analysis of the perceptions regarding the EL of a group of second-year students working towards a degree in primary education at the University of Seville. Of the 54 study participants, 41 were female (75.9%) and 13 were male students (24.1%) aged between 18 and 24. Within the context of a research project (this study is framed within the “Alfabetización Ambiental: Un desafío para el profesorado del siglo XXI” (PID2020-114171GB-I00) project of the Ministry of Economy and Competitiveness of the Spanish government), a didactic proposal on a relevant socio-environmental issue based on the research model was designed and implemented for teacher training in primary education. This proposal combines criteria of progressive complexity in acquiring knowledge related to socio-environmental issues and EE, as well as increasing the resilience of the population. It makes them more resilient and, therefore, better able to adapt to the circumstances of the coming food and environmental crisis.

The main objective was to promote the pre-service teachers’ EL. The central theme of the proposal was the socio-environmental impact of food caused by excessive food production and the subsequent increase in food waste. This all results from inappropriate food management.

Eating is a daily activity commonly performed by most people, and food is, therefore, a topic the students are familiar with. This theme, the focal point of the proposal, helped the students address EL in its different dimensions (knowledge, attitudes and emotions, behaviour, and didactic knowledge). The activities planned in the proposal were therefore directly related to sustainable food. The question that guided the entire process was: “Is it necessary to reinvent our diet?” The content worked on was organized into didactic transitions [34] related to reflective questions that led the process, as well as a set of activities, which served as the guiding thread for students’ reflections recorded in their diaries.

The didactic proposal is based on a science teaching approach oriented towards student research [35–38]. This approach enables students to address relevant questions and problems and prioritise evidence, which allows them to develop and evaluate their own ideas, formulate statements and arguments based on the evidence obtained, assess their explanations considering alternatives, and communicate and justify their conclusions. It is an active methodology based on real-world contexts [39] and on problem-based research, in accordance with similar studies [11,40].

The pillar (or: cornerstone) of the proposal is sustainable food, as eating is an everyday and universal action that all individuals carry out, making it an accessible and relevant topic for students. In addition, food can be approached from an environmental perspective that allows pre-service teachers to understand the interconnection between natural and social systems, as well as the significant impact of food choices on the sustainability of the
planet. This approach helps students to convey the importance of adopting a change in their eating habits, fostering critical awareness of food consumption and production.

The inclusion of food in initial teacher training also responds to the need to integrate EL into various areas of the curriculum, promoting the development of key competencies such as decision-making skills, critical reflection on the environmental impact of our actions, and commitment to sustainable practices.

The didactic proposal was structured in a series of activities, which were, in turn, divided into sessions that guided the EL process, the leitmotif of which was sustainable food. The proposal was presented in those activities. One of them consisted of exploring the students’ preconceptions about the dimensions of EL. Its aim was to find out the students’ level of EL. It included the following tasks: watching a video on the current eco-social crisis, reflecting in groups, calculating the ecological footprint, conducting an experiment on the greenhouse effect, analysing the journey of food in all its phases, introducing the term food miles, holding a round table with experts on sustainable food, making a visit to a permaculture vegetable garden, and creating a sustainable recipe booklet.

Throughout this process, the students wrote entries in their diaries, and at the end of each session, they were asked for guided reflections through open-ended questions about the content worked on in class that day.

The purpose of the study was to explore and understand how a didactic proposal focused on sustainable food influences the EL of primary education students. By analysing the students’ diaries, this study aims to identify the most significant dimensions and categories that affect EL and to detect the anchor points and obstacles to achieving meaningful learning in the environmental context. This, in turn, seeks to contribute to the development of educational strategies that promote deep understanding, pro-environmental attitudes and sustainable behaviour among future citizens. In this regard, the research question developed is the following: What are pre-service teachers’ perceptions of EL?

A descriptive-interpretive approach focused on understanding the students’ perceptions of EL was used. According to Barraza Macías [41], qualitative research, characterised by a naturalistic and interpretive approach, studies phenomena in their natural settings, interpreting their meaning. In this kind of research, descriptive data are produced that are related to what can be experienced within the context in which they are presented [42].

Data Collection and Analysis Tool

Data were collected through the students’ diaries. They contain reflections on the didactic proposal, which allows for the identification of the most important aspects of EL, knowledge, attitudes, emotions, and behaviour.

The diaries contain the students’ guided reflections, which are based on the questions related to the different activities undertaken throughout the teaching proposal. They include the students’ reflections in response to the guidelines proposed to collect their perceptions with regard to the implementation of the different activities of the training process. In each session, the students were asked reflective questions about the content worked on that day in class for them to investigate and reflect on writing a weekly entry. Those reflections were guided, but at the same time, they were autonomous, since, based on the questions asked, the students could continue developing their thoughts independently. This study focuses on those reflections.

To examine the data, an analysis system was designed inspired by the work of Roth [18], Álvarez-García [22,24], Liang et al. [25], and Mello O’Brien [27], stressing the importance of knowledge, affect, behaviour, and emotions, and their relationship with natural and social systems in the context of socio-environmental issues. The dimensions established for the analysis are included in Table 1: (1) knowledge; (2) attitudes and emotions; (3) behaviour; and (4) didactic knowledge. Each dimension is characterised by different categories. Within each category, indicators were established to reflect the level of EL shown in the students’ reflections and ideas. Initially, two levels were defined—the basic level, when the students’ reflections showed few relations and arguments, and an advanced level,
when the students established relations in their reflections and properly supported their arguments. However, throughout the data analysis, it was observed that the EL level of a large number of students was intermediate. They showed some justified and theoretically supported arguments, as well as other simple expressions without relations between them. It was therefore decided to establish three levels within the identification of each category to illustrate the different dimensions.

The information was limited to meaningful units of information (UIs) that were coded as follows: dimension-category-level-unit of information number. For example, a relevant UI on understanding natural systems at an advanced level could be coded as “Knowledge (K)-Natural System (NS)-Advanced Level (AL)-01”. This analysis was carried out using the MAXQDA 2022 qualitative data analysis software. Through this tool, a detailed and accurate coding of the students’ reflections was carried out, allowing for the identification of patterns and recurring themes in their responses. As part of the data processing, a frequency study of the presence of the different indicators was performed. This enabled an analysis of the level of argumentation of the different students’ reflections included in this study.

Table 1. System of dimensions and categories for data analysis.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Category</th>
<th>Indicators</th>
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<tbody>
<tr>
<td>Knowledge (K)</td>
<td>Natural systems (NS)</td>
<td>Basic level (BL): has limited knowledge of natural systems</td>
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<td></td>
<td>Students’ knowledge of the set of elements related to nature</td>
<td>Intermediate level (IL): begins to connect different parts of natural systems with each other, but does not have a complete and unified view of how all those elements interact in an integrated manner</td>
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<td></td>
<td>Eco-social crisis (ESC)</td>
<td>Advanced level (AL): has deep and holistic knowledge of natural systems</td>
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<td></td>
<td>Students’ knowledge of the eco-social crisis related to planetary boundaries</td>
<td>Basic level (BL): recognises the existence of socio-environmental issues related to human lifestyles, but without understanding socio-environmental repercussions</td>
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<td></td>
<td>Diet (D)</td>
<td>Intermediate level (IL): recognises socio-environmental issues related to human lifestyles, and is partially aware of socio-environmental repercussions, but does not have a complete understanding of the magnitude of the repercussions and of the urgency to mitigate them</td>
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<td>Students’ knowledge of diets with low environmental impact, which ensure safety and sovereignty for present and future generations</td>
<td>Advanced level (AL): recognises socio-environmental issues related to human lifestyles as the cause, and has an in-depth understanding of the current situation of socio-environmental repercussions</td>
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Basic level (BL): recognises nutrition as a process in terms of health
Intermediate level (IL): recognises nutrition not only as a process in terms of health, but also has certain awareness of the impact of food on the environment and on society
Advanced level (AL): recognises nutrition as a multidimensional process that has an impact on health, the environment, and society
Table 1. Cont.

<table>
<thead>
<tr>
<th>Dimension (AE)</th>
<th>Category (A)</th>
<th>Indicators</th>
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</thead>
</table>
| Attitudes and emotions (AE) | Students’ assessment, awareness, and emotions regarding the socio-environmental impact of food | Basic level (BL): does not express a commitment towards changing their lifestyle  
Intermediate level (IL): Considers changing, or has the intention to change their lifestyle, but without expressing a firm commitment  
Advanced level (AL): expresses a firm commitment towards changing their lifestyle |
| Attitudes (A)   | Students’ attitudes towards the commitment to adopt (or not) a more sustainable and environmentally friendly lifestyle |                                                                                     |
| Emotions (E)    | Students’ positive or negative feelings and emotions triggered by the eco-social crisis related to the impact of food | Basic level (BL): expresses unconscious feelings and emotions, both positive and negative, about socio-environmental issues  
Intermediate level (IL): expresses conscious emotions about socio-environmental issues, but does not analyse the situation in-depth, and does not reflect on the broader repercussions of the eco-social crisis  
Advanced level (AL): expresses emotions showing awareness of socio-environmental issues; analyses the situation and reflects on reality |

| Behaviour (B) | Intentions and involvement (II) | Basic level (BL): expresses no intention to change their environmental behaviour  
Intermediate level (IL): shows awareness of the need for involvement towards environmental behaviour, but does not clearly define specific intentions to change, and places emphasis on the future  
Advanced level (AL): has a clear intention to change their environmental behaviour |
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<tr>
<td>Students’ assertive manner of behaving related to action</td>
<td>Students’ thoughts and ideas about willingness to change their behaviour</td>
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</table>
| Proposals for solutions (PfS) | Ideas and propositions the students put forward | Basic level (BL): proposes solutions far removed from a view of degrowth. They concern individual behaviour including habits that have little impact in terms of mitigating the eco-social crisis  
Intermediate level (IL): proposes solutions aligned with both individual and collective behaviour that comes close to mitigating the eco-social crisis  
Advanced level (AL): proposes solutions aligned with a view of degrowth that involves alternative resources, oriented towards individual and collective participation towards lifestyles and development models in accordance with planetary boundaries |

| Didactic knowledge (DK) | What to teach (WtT) | Basic level (BL): selects content related to the topic of food focused on health; has limited knowledge of socio-environmental issues  
Advanced level (AL): selects content related to the topic of food focused on degrowth, and on planetary boundaries; has in-depth knowledge of socio-environmental issues |
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<tbody>
<tr>
<td>Students’ proposals for didactic action, which includes content worked on, methodology, and assessment</td>
<td>Content related to EL worked on during the proposal</td>
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</table>
| How to teach (HtT)     | Methodology         | Basic level (BL): presents a teaching-learning process in which the teacher is the only person guiding the process  
Intermediate level (IL): presents a teaching-learning process in which the teacher guides the process, but promotes active participation of the students, encouraging them to collaborate and share ideas through specific activities that may lead to reflection  
Advanced level (AL): presents a teaching-learning process in which the teacher provides resources for the students to think and apply research strategies |
3. Results

The results show the nature and level of the students’ reflections based on the guidelines proposed and collected in their diaries. The findings structured in accordance with the dimensions of the analysis system are presented below. To analyse the categories corresponding to each dimension, the indicators mentioned in the Materials and Methods section (basic, intermediate, and advanced level), based on the students’ EL level, were taken into account.

3.1. Knowledge

The results that correspond to the dimension of knowledge are organised into three categories: natural systems (NS), eco-social crisis (ESC) and diet (D).

3.1.1. Natural Systems

This category corresponds to the knowledge of the set of elements related to nature. The students’ perceptions regarding natural systems are reflected in Figure 1. It is observed that 31.51% of the students’ responses are located at the basic level of EL, a level at which their knowledge of natural systems is limited. They do not associate natural systems with other content, nor do they give them meaning. To illustrate the results, several examples of UIs are provided. The coding of the UIs is shown in the following order: dimension-category-level-unit of information number.

![Natural systems category](image)

Figure 1. Natural systems category.

*In this proposal, we have learnt about combustion processes. I did not know about them, and liked learning about them.* (KNSBL7)

Of the responses, 26.03% are found to be at the intermediate level. The students begin to connect different parts of natural systems with each other but do not have a complex view of how those elements interact in an integrated manner. This can be seen in the following response:

*Other methods to assess our impact on the environment are our carbon footprint (direct/indirect impact of greenhouse gas emissions) and our water footprint (which represents the amount of water consumed, and how it is used to produce a product).* (KNSBL11)

At the advanced level, 42.46% of the students’ responses show a deep and holistic knowledge of natural systems. As an example, the UI below shows that the students associate issues related to the functioning of ecosystems with actions developed by human beings:
In this class, I have learnt about the impact not only of production, but also of transportation. If, for example, we grow products on our land taking care of soil recovery cycles, or using natural resources to avoid pesticides, but then we export these products to other countries, generating an impact because of their transportation, it is absurd. We are generating an unnecessary impact that eliminates the concept of self-sufficiency. (KNSAL15)

3.1.2. Eco-Social Crisis

This category corresponds to knowledge of the eco-social crisis related to the boundaries of the planet. The students express certain ideas that are reflected in their portfolios. Their EL level is illustrated in Figure 2.

![Figure 2. Eco-social crisis category.](image)

At the basic level, 21.15% of the responses show that the students recognise the existence of the socio-environmental crisis but without an understanding of its repercussions. An example is provided below:

*It has helped me realise that generating so much CO₂ generates enormous pollution and problems that affect people’s daily lives. Then, if, apart from CO₂ production, there are thousands of other ways of polluting the planet, what will happen in a few years’ time and what will become of us?* (KESCBL3)

At the intermediate level, 13.46% of the responses show ideas whereby the students recognise the existence of the eco-social crisis, associating it with human activities and with social and environmental repercussions, but do not fully understand the socio-environmental repercussions at a global level. The following example illustrates this:

*This is a worrying fact for the environment because it means that at a general level in our country, more damage is done to the planet than I do myself, and that a change in the routines of all Spanish people is necessary, starting with the education of the future generations.* (KESCBL7)

The majority of the responses, 65.38%, are found at the advanced level, in which the students recognise the existence of the eco-social crisis related to human lifestyles and understand the importance of making changes in their lifestyles. This UI reflects what they expressed:

*This type of livestock farming has a negative impact on what we know as the climate change crisis, due to the exploitation of those animals and the disappearance of natural ecosystems. Therefore, I agree with Carmen and Manuel’s proposal in the talk, and*
consider that it is necessary to resort to and increase the development and value of extensive livestock farming. (KESCAL23)

3.1.3. Diet

This category refers to the students’ knowledge of diets with a low environmental impact that will ensure safety and sovereignty for present and future generations.

The students’ reflections on food in their portfolios were organised into the three EL levels: basic, intermediate and advanced. Their responses can be found in Figure 3.

![Figure 3. Diet category.](image)

As in the case of the eco-social crisis, 8% of the responses are found at the basic level in which the students only recognise nutrition as a health-related process. An example is shown below:

... in this challenge I am learning to eat more fruit every day because, in addition to being beneficial for my body thanks to the number of nutrients fruit contains, it is necessary to ensure numerous functions the body needs to perform every day. Fruit is valuable thanks to the fact that it is mainly composed of water, and contains a lot of vitamins and minerals such as calcium and potassium. Fruit contains carbohydrates such as simple sugars, and fats and proteins as an energy nutrient. (KDBL2)

Next comes the intermediate level in which 36% of the students’ responses are found. The students not only recognise nutrition as a process in terms of health but also have some awareness of the impact of food on the environment and on society. This is how they put it:

We have been able to see that many of the foodstuffs we consume are transported from very distant places to the place where we are going to buy it. The number of kilometres that food travels to reach the supermarkets is generating a lot of CO₂ due to the means of transportation that distributes it to the different shops. (KDBL15)

Finally, the advanced level includes the majority of the responses—56%. Nutrition is here referred to as a multidimensional process that has an impact on health, the environment, and society. One of the UIs found at this level is the following:

It is important to know that our diet has a strong impact on our carbon footprint since it is mainly based on meat and supports non-organic agriculture. It is related to the type of meat we normally consume, to the frequency with which we consume food with high food miles, and to where the products we consume come from. (KDAL21)
3.2. Attitudes and Emotions

The results referring to the attitudes and emotions dimension are divided into two categories: attitudes (A) and emotions (E). The data collected are shown below.

3.2.1. Attitudes

The students’ attitudes towards the commitment to adopt a more sustainable and environmentally friendly lifestyle are reflected in the three EL levels shown in Figure 4.

The majority of the responses, 67.92%, are found at the basic level, which shows the students’ lack of commitment towards changing their lifestyles. This is clear in examples like the following:

We must become aware of the big problem we are facing. (AEABL71)

The intermediate level comes next, with 23.58% of responses. The students have the intention to change their lifestyle but without any firm commitment or specific actions. The following UI shows this:

This has made me reflect on how I can reduce the impact on the environment when purchasing products, leading me to start examining this more in-depth. (AEABL21)

The responses of 8.49% of the students are found at the advanced level in which the students express a firm commitment towards changing their lifestyle to a more sustainable one. In the activity about the journey of food, this UI serves as an example:

I liked doing this activity, because it helped me become aware and be more critical when shopping. Now, I first analyse the labels to see where the product comes from and choose those brands that are made in my town, or as close as possible, to reduce pollution caused by transportation. (AEAAL2)

3.2.2. Emotions

To analyse these data, the students’ reflections related to the values, feelings and emotions, both positive and negative, triggered by the eco-social crisis linked to the impact of food were considered. The results of the three EL levels are shown in Figure 5.
3.2.2. Emotions
To analyse these data, the students’ reflections related to the values, feelings and emotions, both positive and negative, triggered by the eco-social crisis linked to the impact of food were considered. The results of the three EL levels are shown in Figure 5.

The basic level, representing 49.23% of the responses, includes those reflections that refer to unconscious feelings and emotions, both positive and negative, regarding socio-environmental issues. An example of this UI is shown below:

*I feel good when I do things right, e.g., when I recycle or walk to places instead of driving.* (I AEEBL25)

Of the responses, 16.92% are found at the intermediate level, in which the students express conscious emotions but without fully analysing the current eco-social crisis. The following UI provides an example found at this level:

*Currently, I have to admit that due to carelessness, or lack of awareness of the subject, I have never paid attention and have felt indifference to the products I consumed, not caring about the consequences that consuming different products could have on the environment.* (AEEBL15)

At the advanced level, constituting 33.85% of the responses, the students express ideas that show awareness of socio-environmental issues, and they analyse and reflect on reality. The UI below on the activity of calculating the ecological footprint justifies this level:

*It should be noted that, when I saw my results, I was surprised by the number of Earths I needed. However, my surprise was even greater when my classmates mentioned the number of Earths they needed, since I doubled most of them! The number of Earths that would be necessary if everyone behaved the same way I do, would be 6.9, which is practically 7! At that moment, I felt really bad about myself, since I was not aware of the consequences my behaviour has on the environment.* (AEEAL4)

3.3. Behaviour
To analyse the students’ behaviour, those statements related to action and involvement that the students referred to in their diaries were taken into consideration. The behaviour dimension consists of two categories: intentions and involvement (II), and proposals for solutions (PfS).

3.3.1. Intentions and Involvement
In this category, ideas or thoughts the students have about the willingness to change their behaviour were analysed. The results based on the EL levels established can be found in Figure 6.
3.3.1. Intentions and Involvement

In this category, ideas or thoughts the students have about the willingness to change their environmental behaviour were analysed. The results based on the EL levels established can be found in Figure 6.

Of the responses obtained, 37.61% are situated at the basic level, where the students express no intention to change their environmental behaviour. This is clear in the UI below:

My level of involvement is high because I am more motivated every day to reduce my carbon footprint. (BIIBL41)

The intermediate level obtains 38.46% of the responses. The students show awareness of the need for involvement, but do not clearly define specific intentions to change. All this is reflected in the UI in the following example:

All of this helps me for my future profession as a teacher, since I will be able to teach this knowledge to my students and make them aware of how important it is to reduce our carbon footprint. It will also give me tools and knowledge to teach my students the steps to follow to adopt a sustainable diet from a very young age. (BIIBL24)

The advanced level, which contains 23.93% of the responses, reflects the students’ clear intentions to change their environmental behaviour, as shown in the following example:

I am 100% committed and involved in avoiding the use of private transportation to go to places I can get to walking or using public transportation. It makes me feel more committed to the environment, and I feel I take care of our planet. (BIIAL18)

3.3.2. Proposals for Solutions

As for the category of proposals for solutions, referring to the ideas and propositions put forward by the students, the results of the analysis of the students’ level of EL are shown in Figure 7.

The majority of the students’ responses, 55.93%, are found at the basic level. The solutions proposed at this level are far removed from a view of degrowth. Their answers are simplistic and nowhere near proper solutions to socio-environmental issues. An example can be seen in the following UI:

I think we have also realised that we should consume local products whenever possible. Their packaging should be reusable and they should contribute as little as possible to pollution. (BPfSBL20)

It is followed by the intermediate level, obtaining 25.42% of the responses. The proposals for solutions are in accordance with both individual and collective behaviour coming close to mitigating the eco-social crisis, as is observed below:

Change is largely in the hands of the companies and people that have the most power and influence. I currently think that, obviously, those people should be part of the change. However, society, and citizens, can also contribute to a change through individual actions or by acting and fighting in a more collective way. (BPfSBL15)
Finally, 18.64% of the students’ responses are found at the advanced level, in which the proposed solutions are aligned with a view of degrowth. This view implies alternative resources, oriented towards individual and collective participation towards lifestyles and development models in line with the planetary boundaries. The following UI provides a better understanding of the students’ statements:

Moreover, we should bear in mind that, although we can help, companies and people of great influence should also collaborate and, perhaps, we should fight and take action for them to collaborate. This is why our students should be aware so to that they can claim the help they need and deserve. (BPISAL9)

![Proposals for solutions](image1)

**Figure 7.** Proposals for solutions category.

### 3.4. Didactic Knowledge

Related to the students’ proposals for didactic action, which include the content worked on and the methodology, the dimension of didactic knowledge is found. It covers the categories of what to teach (WtT) and how to teach (HtT) in the analysis system.

#### 3.4.1. What to Teach

This category refers to the content worked on related to EL during the didactic proposal. The results obtained after analysing the students’ diaries are shown in Figure 8.

![What to teach](image2)

**Figure 8.** What to teach category.
The results obtained from this category show that the responses of 25% of the students are found at the basic EL level. At this level, the students select content related to the topic of food focused on health and have limited knowledge of socio-environmental issues.

From this experience and from the information I have received and learnt about in class these days, I have learnt the importance of raising awareness amongst our students from an early age about the situation we are experiencing, about how important it is to take measures to solve it. Our students should learn what types of food pollute more than others, put local origin before distant origin, choose what is ecological over what is not... In short, they should know about the importance of those small decisions we make in our daily lives that are very important for the future. (DKWtTBL1)

Of the responses, 75% are situated at the advanced level. Here, the students select content related to the topic of food, addressing the idea of degrowth and planetary boundaries. They have in-depth knowledge of socio-environmental issues.

Once again, what we learn in class is really necessary to bring about a change in the population. If our students grow up being aware of the seriousness of the problem, they will not hesitate to get involved and take measures that in the long run delay the effects of global warming, with everything it entails. (DKWtTAL2)

3.4.2. How to Teach

The analysis of this category refers to the methodology. The results obtained appear in Figure 9.

![Figure 9. How to teach category.](image)

In this case, 61.11% of the responses regarding the methodology are found at the intermediate level. Here, the teacher guides the teaching-learning process in which the investigations carried out through the activities give rise to student reflection. An example is shown in the following UI:

What we learn from this is the importance that comics have in education. They can be used as a resource for students to explore their creativity, narrating their learning process. They also improve concentration and memory, as well as visual literacy and oral and written expression. (DKHtTBL2)

Of the students’ responses, 38.88% reflect a complex level in terms of the methodological process in which the teacher provides resources for students to think and apply research strategies in the EL process.

This is clear in the example below:
I find this project-based methodology more enriching than the traditional one since we, the students, create knowledge and, above all, discover it. To me, it is much easier to remember content that is really worked on than simply transmitted. Furthermore, the evaluation is carried out based on all kinds of projects and efforts and not through a simple test like an exam. This is a relief. (DKHtTAL3)

4. Conclusions and Discussion

This study seeks to contribute to the field of educational research by examining the reflections of a group of pre-service teachers that implement a didactic proposal focused on EL. The aim is to analyse the future teachers’ perceptions, identifying the most significant aspects.

The evaluation of the results obtained reveals that the students understand the connection between EE and their training as future teachers, implying new perspectives, methodologies, approaches and challenges that should be considered to improve the training of teachers with regard to EL. A heterogeneous distribution was observed in the understanding and internalisation of concepts related to the dimensions of knowledge, attitudes and emotions, behaviour, and didactic knowledge.

Based on the data presented, the following conclusions about EL and the training of future teachers may be inferred:

Regarding the knowledge dimension, the natural systems category shows a varied understanding among the students. A significant percentage have a deep and holistic understanding of natural systems, which indicates an advanced and complex perception of how natural environments interact with each other. This understanding is crucial to developing a deep awareness of the interdependence of ecosystems and the need to preserve them.

In the eco-social crisis category, the majority of the students show an acute awareness of socio-environmental issues, especially those related to human lifestyles. This result stresses the effectiveness of EE, as it shows the connection between human actions and global environmental repercussions, fostering a critical and reflective attitude towards sustainability.

The category related to food highlights a greater understanding of its multidimensional importance in health, the environment, and society. Students who show a complex level of knowledge understand that nutrition is not just a biological process, but also a phenomenon that has profound social and environmental repercussions. This comprehensive understanding is key to promote sustainable and healthy dietary practices.

This dimension of knowledge emerges as a central point in the development of EL amongst the participating students. A variety in levels of understanding, from a simplistic and fragmented view to a more holistic and profound insight into natural systems and the eco-social crisis is observed. These results stress the importance of designing educational strategies that promote a deeper and more contextualised understanding of socio-environmental issues, as Liang [25] points out in his study on the level of environmental knowledge, behaviour, and attitudes among university students in Taiwan.

As for attitudes towards the commitment to adopt a more sustainable lifestyle, the results are varied. The majority of the students show a lack of commitment to change their lifestyle, which reflects the need for educational strategies that strengthen motivation and a sense of personal and collective responsibility towards sustainability.

With respect to emotions, most students are aware of the eco-social crisis and are able to analyse it. However, some students do not fully grasp the current situation, which reveals the need to continue working on the emotional dimension of EE to achieve greater internalisation and commitment.

Attitudes and emotions play a significant role in EA training. Although certain tentative attitudes are identified, a varied range of emotions regarding socio-environmental issues, the need to cultivate a stronger commitment to sustainability and behavioural change is stressed [43]. Stanley et al. [44] found that anger provoked by the eco-social crisis
can be highly protective, benefiting both the environment and personal well-being, and can trigger a change in behaviour. These findings reinforce the importance of incorporating educational approaches that promote an emotional connection with nature and foster pro-environmental attitudes.

In terms of behaviour, the students’ intentions and proposed solutions reflect a diversity of levels of commitment and understanding. A considerable number of students show an inclination towards behaviour and solutions in line with sustainability and de-growth, which is a positive indication of the effectiveness of EE in influencing students’ daily practices. In these results, simplistic perceptions and actions focused on individual behaviour prevail, as occurs in other studies like the one of Álvarez. García et al. [22,24] and Marcos-Merino et al. [45]. This is also observed in the study of Hiğde et al. [46], in which pre-service teachers’ behaviour tends to promote climate change mitigation. The comparison between this research and the study of Petkou et al. [15] highlights the importance of environmental education to promote sustainable behaviour. Both studies agree on the need to improve teacher training for effective environmental education.

Finally, as far as didactic knowledge is concerned, the majority of the students show a deep understanding of the relationship between food, sustainability, and planetary boundaries. This knowledge is crucial for the effective teaching of EL. Regarding how to teach, the students have a preference for methodologies that encourage reflection and applying research strategies in the EL process, which underlines the need for educational approaches that promote active participation and critical thinking. Authors such as Parga-Lozano [47] state that environmentalised scientific didactic knowledge is fundamental knowledge in the professional development of teachers, given the lack of training in the environmental field, the absence of specialised courses, and the lack of priority given to environmental topics in the curriculum.

This analysis of the students’ reflections points to a certain influence of the didactic proposal on the EL they participated in, since important aspects were observed in the units of information analysed. The results obtained are in accordance with previous research performed by Aznar Minguet [48], García-González et al. [17], Guerrero Fernández et al. [19], and Guerrero Fernández [49], who stressed the need to address the concept of sustainability and EL in an integrated manner so as to promote greater commitment and socio-environmental awareness. This study, therefore, stresses the importance of continuing to strengthen the training of future teachers in EL. It also encourages a committed attitude towards sustainability and taking care of the environment. Designing educational programmes that promote a deep understanding, pro-environmental attitudes, and sustainable behaviour to effectively address current and future environmental challenges is necessary [48].

One of the main limitations of this study lies in the possible bias in the students’ self-assessment, as they may have adjusted their reflections to align them with the perceived expectations of the researcher or of the training itself. Moreover, data collection through student diaries may be affected by social desirability bias, as the participants may have been influenced by the perception of what is academically acceptable or desired rather than accurately reflecting their true beliefs, perceptions and experiences. Likewise, the duration of the study may not have been sufficient to cause profound and sustainable changes in the participants’ EL levels. Although the dimensions of knowledge, attitudes and emotions, behaviour, and didactic knowledge are addressed, the study could be complemented with a quantitative analysis supporting the qualitative data. This would provide a broader and more generalisable view of EL in diverse educational contexts and could give rise to future research.

This study contributes to the literature on improving EL among pre-service teachers by demonstrating how a food-based approach can be a powerful tool for fostering a deep understanding of and active engagement with sustainability. A practical and effective model that other teacher education programmes could adopt is offered in this paper. By showing how an everyday, relevant approach can transform environmental education,
this research expands the possibilities for incorporating EL into diverse educational contexts, hence contributing significantly to the training of future teachers committed to a sustainable future.

In conclusion, this study provides a valuable understanding of how EL can be integrated and promoted in initial teacher training through a training proposal. Incorporating EL is key to developing effective and transformative environmental education. It would be interesting for educational institutions to adopt comprehensive educational approaches that include practical and reflective experiences, thus promoting deep environmental awareness and a long-term commitment to sustainability. Further research in this field would allow for refining and improving educational strategies, hence contributing to training environmentally conscious and active citizens.


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Institutional Review Board Statement: Ethical review and approval were waived for this study due to REASON (please add the justification). The ethical procedures followed in the research respond to the guidelines of the British Educational Research Association [BERA] (2019) [50] and the APA Ethical Principles (2017) [51]. Particular care was taken with regard to considerations related to the responsibilities to participants (respect the right to dignity; participants’ voluntary informed consent; transparency; privacy and data storage) and the responsibilities for publication and dissemination (making the research findings public for the benefit of educational professionals and available in a language that makes it locally as well as internationally accessible). The ethical considerations and processes that we developed have allowed us to conduct our research “within an ethic of respect for: the person; knowledge; democratic values; the quality of educational research; and academic freedom” (Ref. [52], p. 5).

Informed Consent Statement: Students declared their agreement to participate in this research for academic purposes and confidentiality requirements.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding authors.

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

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