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Biology and Geology Teachers and Ecoethics Education: From the Guidelines and Training Offered to the Training Needs Felt by Teachers

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Abstract: Ecoethics studies the moral relationship among human beings, the environment and its non-human components, whereas education for ecoethics involves a reflexion on how to live, how to make environmental choices and how to think about the consequences of human activities. To promote this reflexion, teachers must be able to teach subjects related to ecoethics, having adequate teacher training in the field. Thus, it was considered pertinent to investigate if and how ecoethics appears in the guiding documents for teachers' practices and in initial and continuing training courses for Portuguese biology and geology teachers, as well as whether these teachers feel they need training in ecoethics. To achieve this, document analysis was carried out, and a questionnaire with both close- and open-ended questions was applied at a national level. The main results show that little emphasis is given to ecoethics both in the guiding documents and in initial and continuing training courses for Portuguese BG teachers; most teachers say that they have not dealt with ecoethics issues in their initial and ongoing teacher training but consider them essential. Given the teachers' influence on students, a focus on teacher training in ecoethics is essential so that they can contribute to solving environmental problems.

Keywords: biology and geology teachers; ecoethics; education for ecoethics; initial and continuing teacher training; teaching practice guidance documents; teacher training needs; science education; science teachers

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1. Introduction

There are many environmental challenges that the planet faces today, from floods and fires to landslides [1]. Given this ecological crisis, resulting from the relationship that human beings have built with the natural environment [2], the need to apply ethics to environmental issues has arisen. It is imperative that human beings reflect on the relationship that they have established with the natural environment, recognising the existence of environmental problems and seeking to outline moral obligations in the face of these problems [3,4]. This ethical relationship between human beings and the natural environment defines environmental ethics, a discipline within philosophy also known as ecoethics [5–10].

As science seeks to provide answers in areas where controversies are present, environmental issues often raise ethical questions. Calls for the inclusion of ethics in science education have been made with the aim of enhancing the understanding of the nature of science and improving the ethical sensitivity, knowledge and ethical judgement of both teachers and students, enabling them to understand environmental issues both in terms of scientific content and appropriate ethical points of view [11]. Thus, science education that includes ecoethical issues can help to make society aware of the current environmental situation and the viable solutions to solve them. The fundamental role of science education in promoting active and responsible citizenship is often emphasised, from which the ethical

component cannot be disassociated. Given the above, it was considered pertinent to analyse in this article whether and how ecoethics issues appear in teaching practice guidance documents in teacher training courses, as well as whether teachers feel they have training needs in this area.

The relevance of ecoethics has been affirmed as a contribution to resolving the environmental crisis of today by promoting reflection on the relationship between human beings and the natural environment [12]. Other entities are now considered at the centre of reflection and action, rather than exclusively human beings, as was the case until very recently [13]. This leads us to the two main environmental ethics matrices: anthropocentric environmental ethics and non-anthropocentric environmental ethics. While anthropocentric environmental ethics considers the human being as the unique moral subject, non-anthropocentric environmental ethics considers several moral subjects, depending on the approach, assigning moral status either to living beings (biocentric ethics), sentient beings (animal ethics), non-living beings and ecosystems (ecocentric ethics) [13,14]. In general terms, ecoethics presupposes reflection on the ethical significance of living entities, whether conscious or not, and non-living entities, whether singular or collective [3]. Ecoethics continues to evolve and expand, as environmental challenges persist, and new ethical dilemmas arise. It provides a structure for evaluating the moral dimensions of human actions in relation to the natural environment, promoting pro-environmental practices and fostering a deeper understanding of the ethical responsibilities of human beings in relation to the natural environment.

Given its relevance, ecoethics is currently in the focus of several areas of contemporary sciences, such as science education, as societies are facing several environmental problems that result from the relationship between the natural and social dimensions of the world [15,16]. Ecoethics can provide valuable tools in the transition from moral reflection to action and effective policies in favour of the environment [15]. Science education plays an important role in developing an understanding of the concepts that underpin environmental issues, potentially leading to pro-environmental behaviour [17], as well as supporting scientific arguments to justify actions that jeopardise natural resources [18]. Scientific knowledge helps to awaken an awareness of ethical challenges that can justify and drive moral imperatives [18]. Thus, the relationship between ecoethics and science education should be complementary, as science education provides the basis for knowledge and understanding of the natural world, while environmental ethics guides ethical considerations and decision-making in human interactions with the natural environment [19,20]. This relationship supports the development of environmental literacy [21], which is considered as the knowledge, skills, attitudes and values that enable individuals to understand and address environmental issues. This way, individuals are able to make choices in favour of the environment [21].

An awareness of the complexity and multidimensionality of the earth as a whole requires new ways of reflecting, critical thinking, ethical analysis and logical skills, as well as problem-solving skills in order to reverse human characteristics and behaviours that compromise the health of the planet [16,18]. It is in this sense that educational institutions, which are places where knowledge is produced and shared, play a very important role in harmonising human actions ethically towards the natural environment [16].

A sense of crisis may have been enough to direct the focus towards education, increasing the value of environmental ethics in the public consciousness and leading to ethical issues being part of the educational agenda in many countries [1]. Schools often tend to create environments where students are isolated from nature, not preparing them to be well-informed and conscious citizens or for the challenges that lie ahead [16]. Thus, it seems crucial to rethink the entire educational paradigm and learning system, including curricula, pedagogical strategies and school management frameworks, creating some theoretical and practical alternatives so that schools can deal with environmental issues, providing adequate and effective responses [16]. Education for environmental ethics can therefore be considered as a kind of response to environmental crises [1] and can be formally included

by education ministries in national curricula or addressed by teachers in their classes, even when there is no explicit curricular focus [1]. This ultimately shows how relevant the role of the teacher can be in this context. Teachers profoundly influence what and how students learn. This influence extends far beyond the conceptual components of each curriculum, as it includes teachers' beliefs, philosophies, attitudes and behaviours, as well as their ethical views [1,22]. These influences often mark students and last throughout their lives, whether in a positive and/or negative way [23]. These influences guide their future decisions [1], with the aspects that mark them most being those related to the ethical behaviour and values of their teachers [23]. Training in environmental ethics must not only involve the cognitive process of learning analytical skills, but also foster ethical awareness and attitude through critical reflection, which may require position-taking [18]. This seems to suggest that a commitment to ethical teacher training should be a starting point for inevitable environmental change [23], thus emphasising the need for and importance of greater investment in both initial teacher training (ITT) and in continuing teacher training (CTT) in environmental ethics. According to some studies on the training needs of science teachers in matters related to ecoethics, some teachers consider that their training in ecoethics is often insufficient for them to be able to promote the (re)construction of environmental knowledge and values in their students [24]. Some teachers consider that awareness of ecoethics increases with the frequency of ecoethics training [25], and others consider that the quality of their ecoethics training is often inadequate [25]. Some teachers think that their ecoethics training needs to be improved [26,27], and others consider the approach to controversial issues to be pedagogically problematic because the authority of the teacher as a specialist in the subject is often challenged, and they consider it necessary to approach these topics in a different and more effective methodological way [21]. Finally, another study [23] suggests that there is a lack of reflection on environmental problems and curricula by science teachers. These studies seem to emphasise the need for ITT and CTT to be ecoethics-oriented or to provide the necessary training in this field.

In addition to ITT and CTT in biology and geology, which is essential for the teaching profession, there are guiding documents for teachers' teaching practice that accompany and regulate teachers' actions throughout their professional career. These are their reference documents when teaching their classes until the end of their teaching career. Guiding documents are understood as a set of related curriculum documents and are made for teachers. They can include syllabi, learning objectives, programmes, etc., and should provide information that prescribes what should be taught in each specific school subject [28]. In general, they should provide information on disciplinary and transdisciplinary learning outcomes, the content to be covered in each school subject, as well as the teaching methodologies to be adopted [29,30]. Guiding documents act as a kind of guide for teachers in terms of what their students are expected to learn and, consequently, what they are expected to teach. Given the nature of these guiding documents, frequently, if certain contents/themes are not included in them, there is a strong likelihood that they will not be addressed by teachers in their lessons [28]. On the other hand, it can also be said that even when present within the guiding documents, teachers may not always address them. This means that, often, addressing these contents/themes may depend on the teacher's sensitivity to them. Generally, teachers teach based on the guidance documents for the subject they are qualified to teach. For the particular case of Portugal, it is important to note that the country is currently undergoing a reformulation of its curricular documents, many of which were repealed in 2021 (such as the National Curriculum for Basic Education) and have not yet been replaced by equivalent ones. Thus, this situation may have implications for teachers' teaching practices and, consequently, for the students' learning process. The literature shows precisely that teachers tend to focus on fulfilling the objectives of the specific programmes of the subject they teach [28], which can condition the approach of ecoethics issues if they are not formally part of these documents. In curricular terms, the indications given by the Portuguese Ministry of Education are unclear and not very explicit regarding the inclusion of issues related to ecoethics or even non-existent in the guidelines

of some subjects [23]. Nonetheless, efforts have been made to include these themes in teaching practice guidelines [28], in general. In Portugal, these themes appear mainly in the National Strategy for Citizenship Education (NSCE).

This research falls under three sustainable development goals (SDGs), considered a set of universal and transformative goals and targets to achieve a better future for all [31], namely SDG4, SDG 12 and SDG 13. Regarding SDG 4—'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all', this research makes its contribution to teachers by imparting the knowledge and skills necessary to promote ecoethics education in order to indirectly contribute to solving current environmental challenges. Concerning SDG 12—'Ensure sustainable consumption and production patterns', this research facilitates teachers' access to relevant information and fosters awareness of environmentally sustainable development and lifestyles in harmony with nature. Regarding SDG 13—'Take urgent action to combat climate change and its impacts', this research contributes to the improvement of education, raising awareness about mitigation, adaptation, impact reduction and early warning measures in relation to climate change, considered one of the most important environmental problems of the present time.

Thus, as it is necessary to sensitise and make citizens aware of the ethical attitudes towards environmental problems, it is necessary to intervene with students, the future representatives of society. Considering that teachers play a central role in the formation of informed, active and responsible citizens, then, the research question of the present study is to investigate how ecoethics fits into teacher training. To this end, this research is made up of two studies. The first study is centred on what the Portuguese Ministry of Education defines in the guiding documents regarding education for ecoethics. The second study is centred on teacher training needs in education for ecoethics, which includes a review of the existing training offer for biology and geology (BG) teachers and an analysis of their perceived training needs regarding ecoethics issues. Each study has specific research questions. Concerning Study 1, the goal is to find out whether issues related to education for ecoethics are addressed and/or referred to in the guiding documents of BG teachers' practice. This first study provides scientifically relevant information, as it makes it possible to ascertain which pedagogical guidelines on ecoethics are expressed in the documents that regulate teachers' professional activity, which they must comply with. Concerning Study 2, its goal is to find out whether issues related to education for ecoethics are addressed and/or referred to in the syllabi of ITT and CTT in BG, as well as to identify the possible training needs of BG teachers who teach in the third cycle of basic education and in secondary education within Portuguese schools, focusing on issues related to ecoethics. This second study provides scientifically relevant information, as it provides information on the initial training currently provided to future biology and geology teachers at Portuguese public universities, which will affect the teaching and learning process of future basic and secondary school students. This second study also makes it possible to explore the continuing training in ecoethics available to in-service teachers, as well as their perception of their training needs in ecoethics. The results of this research may be relevant for BG teacher trainers, as well as for BG teacher training institutions, making it possible to create both initial and continuing teacher training courses that provide training in ecoethics education.

2. Methodology

2.1. Study 1

In Study 1, guiding documents of the BG teaching practice were analysed. This study required qualitative research, as it involved collecting data to describe and analyse the characteristics or variables of a specific documentary corpus [32].

To carry out this first study, which involved consulting and analysing documents during the 2022/2023 school year, guiding documents for the teaching practice of teachers who teach biology and geology (BG) in the 3rd cycle of basic education and secondary education (7th to 12th grade, i.e., 12 to 18 years old), in effect in Portugal, were consid-

ered. According to information provided by Portugal's Directorate-General for Education, guiding documents are currently organised into three curricular references: compulsory education students' profile; natural sciences learning goals; and National Strategy for Citizenship Education, as shown in Table 1, along with their corresponding descriptions.

Table 1. Main curricular references by Portuguese Ministry of Education.

Code	Curricular Reference	Description
A	Compulsory education students' profile (Dispatch no. 6478/26 July 2017)	A reference document for the organisation of the entire education system, structured around principles, vision, values and areas of competence, contributing to the convergence and articulation of decisions inherent in the various dimensions of curriculum development.
B	Natural sciences learning goals (Dispatches no. 6944-A/19 July 2018 (Basic Education) and 8476-A/ 31 August 2018 (Secondary Education))	They aim to promote the development of the areas of competences set out in the students' profile, and constitute a common set of knowledge to be acquired, identified as the contents of structured disciplinary knowledge, which are indispensable, conceptually articulated, relevant and significant, as well as the skills and attitudes that all students must develop in each component of the curriculum or subject, usually with reference to the year of schooling or training.
C	National Strategy for Citizenship Education (Dispatch no. 6173/10 May 2016)	This strategy should be consolidated so that students experience and acquire citizenship skills and knowledge in various areas throughout the different school cycles, namely, values and concepts of national citizenship, human rights, gender equality, non-discrimination, interculturality, inclusion of people with disabilities, health education, education for sexual and reproductive rights and road safety education.

In order to facilitate data processing and analysis, a brief description of the analysed documents is presented as follows:

- The curricular reference 'Compulsory education students' profile' is made up of one document (A) [33], which covers all subject areas and all school years of compulsory education (1st to 12th grade, i.e., 6 to 18 years of age).
- The curricular reference 'Natural sciences learning goals' (B), regarding BG subjects, is made up of seven documents, spanning seven school years: B1 to B3 [34–36] are designated for learning goals in the subject of natural sciences, school years 7th, 8th and 9th, respectively; B4 and B5 [37,38] are designated for learning goals in the subject of BG, school years 10th and 11th, respectively; B6 is designated for learning goals in the subject of biology, 12th school year [39]; and B7 is designated for learning goals in the subject of geology, 12th school year [40].
- The curricular reference 'National Strategy for Citizenship Education' (C) covers all subject areas and all school years of compulsory education, with two documents of relevance to the BG subject and ecoethics: the Environmental Education Guidelines for Sustainability (C1) [41]; and the Development Education Guidelines (C2) [42]. Globally, the National Strategy for Citizenship Education includes different areas of citizenship education, which are organised into three groups with different implications. The first group is a mandatory domain for all levels and cycles of schooling. This domain includes transversal and longitudinal areas, and two of those areas are environmental education (which includes document C1) and sustainable development (which includes document C2). These are particularly relevant because the role of ecoethics has greater expression in them.

In summary, for this documentary analysis, 10 documents were considered, currently in effect, with different meanings and relevance.

In order to respond to the aim of this first study—whether and how issues related to ecoethics are addressed in curriculum documents—a priori categories and subcategories were created. These categories of analysis form, on one hand, the areas of competences that students should acquire during their school journey (knowledge, skills, attitudes) [33], based on the information contained in the students' profile (doc A) [33], and on the other hand, the way in which (Methodology) students are intended to acquire these competences.

Thus, the categories analysed are: conceptual knowledge, which has to do with the conceptual component underlying the theme of ecoethics, encompassing conceptual issues, ecoethics main matrices and environmental problems and/or dilemmas; cognitive abilities, which has to do with the cognitive abilities that students must develop throughout their school journey in relation to the environment, namely, thinking, reflecting, learning and reasoning about related issues; attitudes, which has to do with the attitudes that students must develop throughout their school career towards the environment, including environmental awareness, ethical values and ethical behaviours; and methodology, which has to do with the approaches and resources for teaching ecoethics-related subjects. The content of these documents was then analysed and classified based on the a priori categories and subcategories defined.

Table 2 shows the categories and subcategories with a brief description of their classification criteria in order to make this information more explicit.

Table 2. Categories, subcategories and classification criteria.

Category	Subcategory	Classification Criteria
Conceptual knowledge'	Mention of the terms ecoethics and/or environmental ethics	Presence or absence of the word ecoethics and/or environmental ethics
	Definition of the concept of ecoethics and/or environmental ethics	Presence or absence of a definition of the concept of ecoethics and/or environmental ethics
	Underlying epistemological trend	Presence or absence of a tendency to position in one of the matrices (anthropocentric vs. non-anthropocentric)
	Mention of environmental problems and/or dilemmas	Presence or absence of reference to specific environmental problems
Cognitive abilities	Memorisation	Presence or absence of references to memorising information
	Critical thinking	Presence or absence of references to thinking comprehensively and in depth, logically, observing, analysing information, experiences or ideas, with a view to taking an informed position
	Reasoning and problem solving	Presence or absence of references to processes of finding answers to a new situation, mobilising reasoning with a view to making decisions, constructing and using strategies and possibly formulating new questions

Table 2. *Cont.*

Category	Subcategory	Classification Criteria
Attitudes	Environmental awareness	Presence or absence of references that motivate understanding of the balance and fragility of the natural world, expressing environmental awareness and responsibility, working for the common good
	Ethical values	Presence or absence of references to the development of values (orientations) according to which certain beliefs, behaviours and actions are defined as appropriate and desirable, understood as the ethical elements and characteristics expressed through the way people act and justify their way of being and acting
	Ethical behaviour (acting ethically)	Presence or absence of references to ethical actions and behaviour for the common good
Methodology	Teaching approaches	Presence or absence of teaching approaches for teaching subjects related to ecoethics
	Teaching resources	Presence or absence of teaching resources for teaching subjects related to ecoethics

2.2. Study 2

Study 2 is made up of two parts. The first part analyses the syllabi and respective subject/contentsof BG ITT and CTT courses offered by public higher education institutions (PHEIs), which include subjects related to education for ecoethics, while the second part of this study focuses on detecting the training needs of BG teachers in relation to the subject.

The first part of Study 2 required carrying out qualitative research, as it involved collecting data to describe and analyse characteristics or variables of a specific documentary corpus [32]. In order to carry out this part of the study, which involved consulting and analysing information available online for the 2022/2023 academic year, public PHEIs were considered, which, according to the Portuguese Basic Law of the Educational System (Law no. 46/86, October 14), includes both university and polytechnic education, with a total of 24 PHEIs. It is important to note that current ITT in Portugal has adopted the Bologna process model for the organisation of higher education since 2006 by Decree-Law no. 74/2006, of 24 March. For the specific case of analysing ITT at PHEIs, five of them were considered because, according to the information provided by A3ES, the Agency for Evaluation and Accreditation of Higher Education (established by the Portuguese State through Decree-Law 369/2007, November 5), these institutions are the ones that have accreditation in effect for BG ITT in their training offer. In the case of the CTT, all 24 PHEIs were taken into account, as well as master programmes, postgraduate and short courses that BG teachers could attend. It should be noted that taking CTT is a compulsory requirement for all teachers in the Portuguese education system and that they have the opportunity to choose the CTT courses they wish to attend. Continuing training courses offered by institutions other than PHEIs (e.g., training centres of school associations) are not included, mainly because detailed information about the training in question is not available on the Portuguese Scientific-Pedagogical Council for Continuing Education's website; only the titles of the training courses are provided, thus lacking sufficient elements for a rigorous analysis.

Once the documentary corpus had been identified, a 'floating reading' was carried out to get to know its structure and content [32]. Therefore, and given the nature of the research question of this study [32], data were collected by consulting the syllabi of the courses on the PHEI websites in order to analyse the existence of content related to education for ecoethics in the ITT and CTT courses. It was decided to make the enquiry using the information

available online on the websites of the PHEIs for reasons of easier access and because it is probably the preferred way for potential students (teachers) to look for information when applying for a particular higher education course. To maintain the confidentiality of the PHEIs, a database was created, available only to researchers, where the PHEIs appear with codes from PHEI1 to PHEI24 (numbering assigned in order of entry into the database), with each code corresponding to one PHEI.

In the specific case of the ITT courses, the categories of analysis were defined a posteriori, focusing on aspects relating to the presence of ecoethics-related subjects in the content of the curricular unit (CU) in the syllabi of each course, as well as the scope of the CU and its content related to ecoethics education. In the case of the CTT courses, the categories of analysis were also defined a posteriori, focusing on aspects relating to the presence of issues related to education for ecoethics in the content of the CU in the syllabi of each course, as well as the type and scope of the course and the scope of the CU.

In this first part of Study 2, the same categories from Study 1 were not used to do this analysis, as the information we obtained online about the courses (ITT and CTT) was considered insufficient (study plans in their simple form).

ITT and CTT courses and their respective syllabi whose subjects/contents were not available for online consultation were not considered for the analysis. The conditions of confidentiality and anonymity of the PHEIs were guaranteed.

The second part of Study 2 required quantitative, non-experimental, descriptive research since it involved collecting data to describe and analyse the characteristics of a specific population [32] and included the processing and analysis of closed and open-ended questions.

The population was made up of BG teachers teaching in public schools/groups of schools (S/GS) in mainland Portugal in the 2021/2022 school year. All BG school teachers teaching in public schools in Portugal, who were affiliated with the 3rd cycle and secondary schools and had3 or more years of service, were invited to take part in the study. This resulted in a sample of 293 teachers. To analyse and interpret the data, absolute and relative frequency values were first calculated according to the answers given by the participants to the questions examining their sociodemographic characteristics (Table 3), within the dimension of the questionnaire referring to personal and professional data, namely, gender, age, professional qualifications, length of service, contractual situation and the predominant level of teaching in the last 3 years.

Table 3. Sociodemographic characteristics of the Study 2 sample (n = 293).

Categories	Subcategories	f	%
Gender	Female	235	80.2
	Male	57	19.5
Age	40 years old or less	13	4.4
	41–50 years old	107	36.5
	51 years old or more	173	59.0
Professional qualifications	Degree in teaching/educational branch (pre-Bologna)	256	87.4
	Master in teaching (post-Bologna)	11	3.8
	In-service professionalisation or equivalent	26	8.9
Time in service	15 years or less	39	13.3
	16–25 years	79	27.0
	26 years or more	175	59.7
Contractual situation	School board	221	75.4
	Pedagogical zone board	17	5.8
	Hired	54	18.4
Level of education predominantly taught in the last 3 years	3rd cycle of basic education	142	48.5
	Secondary education	151	51.5

Analysing Table 3, it can be seen that the sample is made up of around 80% female respondents, mostly from higher age groups, aged 51 or over (59%). Around 87% of the respondents have professional qualifications at degree level and long times of service, with 26 or more years of service (59.7%). Respondents are mostly from the school board (75.4%); around 49% of them mention teaching predominantly in the 3rd cycle of basic education and around 51% mention teaching in secondary education. In addition to these main characteristics, it was also possible to ascertain that the majority of respondents (63.1%) did not attend any further academic training in addition to their initial teacher training and that they represent all districts of Portugal, with the most represented cities being Porto (18.1%), Lisbon (14.3%) and Braga (13.3%). Finally, respondents often had management functions, namely, as head teachers (66.6%).

Given the nature of the aim of this second study [32], data were collected using the survey technique. This technique, usually applied to a group of individuals (respondents), allows information to be collected in order to analyse, interpret and draw conclusions, with a view to answering the research questions [32]. Therefore, a questionnaire survey was applied, using the Google Forms tool, to BG teachers who taught in public S/GS in mainland Portugal. In order to collect data for this study, in addition to the data that characterises the sample socio-demographically, the questionnaire's dimension 'Teachers' training needs in ecoethics' was analysed, consisting of four closed-ended questions and four open-ended questions about their ITT and CTT in ecoethics.

The questionnaire was built from scratch, as no data collection instruments were found that could be used or adapted in this research to obtain the desired information. It was based on the literature review carried out previously, namely, on science teachers' perceptions of the insufficiency of their training in ecoethics (conceptual and methodological) and the need to receive it in order to teach the subject's content. Given that the aim of this dimension of the questionnaire was to gather information on the training in ecoethics that the teacher respondents mentioned having received, as well as the training needs they felt, four closed-ended questions and four open-ended questions were asked. The open-ended questions were intended to explore or justify the answers given in the closed-ended questions. The latter were intended to gather information on whether teachers had received ITT and CTT in ecoethics, as well as their opinions on the inclusion of this subject in ITT and CTT. The questionnaire was subjected to a content validity analysis [32] by three experts in science education and by three BG teachers with similar characteristics but were not part of the sampled group. On one hand, this validation allowed the experts to analyse the questions in the questionnaire and give their opinion on their relevance and sufficiency for obtaining the desired information. On the other hand, the participation of BG teachers with similar characteristics, but who were not part of the sample, made it possible to carry out a pre-test in order to subsequently make the necessary adjustments to the questions, according to the feedback received from them. These teachers were given the opportunity to answer the questionnaire and to comment on individual items and the questionnaire as a whole. They were asked to reflect on the clarity and wording of the questions, in particular, whether there were any spelling or grammatical errors, the wording of the sentences, any difficulties in understanding the sentences and meanings, as well as possible suggestions for improvement [32]. After this process, the questionnaire was also authorised for use in the school context by the Portuguese Ministry of Education and by the University's Ethics Council.

When processing the data, categories were defined a priori for the closed-ended questions and the participants' responses were classified based on these categories. For the open-ended questions, categories were defined a posteriori, based on the participants' responses. Some answers had parts that were included in different categories, meaning that sometimes the same answer was included in more than one category. Answers that were not aligned with the interview questions were excluded from the results analysis.

The conditions of confidentiality and anonymity of teachers and S/GS were guaranteed. Respondents were informed about the research and asked to agree with the conditions before proceeding to answer the questionnaire.

3. Results and Discussion

3.1. Study 1: Education for Ecoethics in Guiding Documents for the Teaching Practice of BG Teachers

Given the importance of guiding documents in regulating teachers' teaching practices, it was considered pertinent to see if and how issues related to education for ecoethics are mentioned. Thus, the versions of 10 guiding documents for teaching practices in natural sciences, biology and geology were consulted, as mentioned in the methodology section.

Tables 4–7 have been produced from consulting and analysing these documents, where the presence and respective subjects with some relation to education for ecoethics in each of the guiding documents are exposed. As Table 4 shows, only document C1, the referential for the framework of environmental education for sustainability [41], explicitly mentions environmental ethics. It emphases the importance of environmental ethics as an essential area of knowledge in environmental education for solving current environmental problems, as well as gives a definition of it (Table 4). This document also gives a definition of ethics as the moral principles by which an individual governs their personal or professional behaviour [41] (p. 111). In no other document does this conceptual component appear so explicitly. In addition, this document contains the historical context of environmental education, an area in which ecoethics is included, presenting the main historical milestones in the world in general and in Portugal in particular.

Table 4. Analysis of guiding documents regarding conceptual knowledge on ecoethics.

Conceptual Knowledge	Guiding Documents										Examples
	A	B1	B2	B3	B4	B5	B6	B7	C1	C2	
Mention of the terms ecoethics and/or environmental ethics	-	-	-	-	-	-	-	-	X	-	Recognise the need for environmental ethics in the face of sustainability challenges (C1, p. 66)
Definition of the concept of ecoethics and/or environmental ethics	-	-	-	-	-	-	-	-	X	-	The ability to reflect on the value we attribute or should attribute to the environment and the values that guide or should guide our relationships with it (C1, p. 111)
Underlying epistemological trend	X	X	X	X	-	X	-	-	X	X	Recognise the importance of using natural resources consciously so as not to compromise the needs of future generations (C1, p. 67)
Mention of environmental problems and/or dilemmas	-	-	X	-	-	-	X	X	X		Explain how pollution, deforestation, fires and biological invasions can affect ecosystems (B2, p. 10)

X: present, -: absent.

Regarding the presence of an epistemological trend (an anthropocentric environmental matrix or a non-anthropocentric matrix), as showed in Table 4, it is not always easy to identify a trend, which was the case with documents B4, B6 and B7 [37,39,40], mainly due to a more content-centred approach to the subject. Documents A, B1, B2, B3, B5, C1 and C2 [33–36,38,41,42] seem to tend towards the anthropocentric environmental matrix, which is a conceptual framework that recognises the interdependence between human beings and the environment and emphasises the central role of human beings in environmental decision-making and the responsibility to sustainably manage natural resources. Concerns for human self-interest and well-being have been the most powerful argument and moral

force for the creation of policies and legislation aimed at promoting the protection of the natural environment and environmental sustainability [8], as is the case with the ethics of Hans Jonas, whose concepts of 'future generations' and the 'principle of precaution' have been adopted by the UN in the framework of environmental policies. This Principle raises the issue of human responsibility towards future generations, arguing that the impacts of human behaviour on the environment degrade and compromise the quality of life of future generations, which requires a reconfiguration of ethics from current generations, centred on human responsibility for the preservation of planetary life [43]. Document C2 [42], unlike the others, makes some references to the importance of planetary balance and planetary community, such as, to 'recognise global citizenship as an ethical and civic commitment based on a sense of belonging to the planetary community' [42] (p. 53).

With regards to specific environmental problems, as shown in Table 4, they are explicitly mentioned only in documents B2, B6, B7 and C1 [35,39–41]. In the other documents, the existence of environmental problems is implied, although it is not made clear which ones.

Globally, regarding conceptual knowledge, the documents seem to be centred more on the notions, sometimes understood atomistically, where the human being appears as an observer, apart from natural processes, with the ability to affect them, but apparently without being affected by them. With life on earth at stake, both human life and that of other species, which sustains the web of relationships that maintain life and the quality of life on the planet, these documents seem to lack a global vision of the concepts inherent in their own interactions, as well as of the place of human beings in this chain, where they affect the natural environment and are also affected by it.

Regarding cognitive abilities, Table 5 shows that all the documents provide orientation to teachers so that they can motivate critical thinking, reasoning and problem-solving skills in students. Memorisation and comprehension, on the other hand, are more explicit in the documents relating to learning goals—B1 to B7 [34–40].

Table 5. Analysis of guiding documents regarding cognitive abilities on ecoethics.

Cognitive Abilities	Guiding Documents										Examples
	A	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	
Memorisation and comprehension	-	X	X	X	X	X	X	X	-	-	Memorisation, verification, and consolidation tasks associated with understanding (B3, p. 7)
Critical thinking	X	X	X	X	X	X	X	X	X	X	Critical reflection on the interdependence between personal and collective choices and public policies in building a planetary community (C2, p. 67)
Reasoning and problem solving	X	X	X	X	X	X	X	X	X	X	Presence of examples of participatory and co-responsible action by citizens and various institutions that can contribute to tackling local, national and global problems and conflicts (C2, p. 41)

X: present, -: absent.

As far as attitudes towards the environment are concerned, Table 6 shows that the majority of learning goals documents—B1, B3, B4 e B5 [34,36–38]—does not seem to clearly include information on environmental awareness, ethical values and ethical behaviour. With regard to learning goals, these aspects appear more in the curricular years, in which the topic of resource sustainability is addressed—documents B2 and B6 [35,39]. However, documents C1 and C2 [41,42] are the ones that deal with these aspects more explicitly, invoking concepts such as values, ethics, responsibility and environmental awareness (C1,

C2); intrinsic and instrumental values; and valuing animal welfare, care and planetary community (C2).

Table 6. Analysis of guiding documents regarding attitudes on ecoethics.

Attitudes	Guiding Documents										Examples
	A	B1	B2	B3	B4	B5	B6	B7	C1	C2	
Environmental awareness	X	-	X	-	-	-	X	X	X	X	Showing social and environmental awareness and responsibility, working collaboratively for the common good (A, p. 27)
Ethical values	X	-	X	-	-	-	X	-	X	X	Expressing respect for human beings, animals and plants (C2, p. 22)
Ethical behaviour (acting ethically)	X	-	X	-	-	-	-	-	X	X	Knowing how to act ethically, being aware of the obligation to answer for one's actions (A, p. 17)

X: present, -: absent.

Regarding the methodological component, Table 7 shows that all the documents mention teaching approaches, with the exception of document C2 [42], and they all mention resources that can help teaching practice, with the exception of documents C1 and C2 [41,42].

Despite appearing in practically all documents, the teaching approaches mentioned are often generalized to cover teaching content. This is especially relevant in learning goals—B1 to B7 [34–40]. This means that it is not clear which approaches are most appropriate for teaching certain content or, in this case, which approaches are considered most effective in addressing issues related to ecoethics. The same goes for the teaching resources.

Table 7. Analysis of guiding documents regarding the methodological components for teaching subjects related to ecoethics.

Methodology	Guiding Documents										Examples
	A	B1	B2	B3	B4	B5	B6	B7	C1	C2	
Teaching approaches	X	X	X	X	X	X	X	X	X	-	Organising debates that require supporting statements, elaborating opinions or analysing facts or data (B2, p. 8)
Teaching resources	X	X	X	X	X	X	X	X	-	-	Using a variety of materials and tools, particularly information and communication technologies (ICT) (B7, p. 4)

X: present, -: absent.

In summary, although the need for critical attitudes, reflection and analysis regarding environmental and sustainability issues is reinforced in all documents, teachers are not given sufficiently clear and in-depth guidelines on how to incorporate these elements into their lessons. It can also be seen that there is greater depth in the subject, especially in C1 [41], as one progresses through the years of schooling. However, there are studies that show that the age of students is important for the development of their ethics, in that when students are exposed to ethical issues and dilemmas from an early age, they are more likely to challenge their personal ethics and adopt new perspectives and, conversely, the older they are, the more difficult it becomes to change their ethical beliefs [1]. This seems to indicate that tackling these issues from an early age can facilitate the learning of an

environmental ethic, which is necessary to tackle the current ecological crisis [2]. In C1 [41], it appears that the development of environmental ethic is mainly in a behaviourist version, but it is coherent and well-founded. Whilst this is not the guiding document to which the most importance is attached, it does provide relevant information in the field of education for ecoethics.

In general, with regard to the teaching practice guiding documents analysed in this study, perhaps they need to explain more clearly how they can promote education for ecoethics. Documents C1 and C2 [41,42] could perhaps be a starting point for this realisation, as they have more information on the subject. It is important to note, however, that these last two documents, although considered relevant, are valued lower than the other documents when it comes to guiding teachers' teaching practice. The fact that documents A [33] and B1 to B7 [34–40] are given more prominence makes the other two documents less decisive.

These observations are in line with some recent studies, which show, in particular, that the current curricula need to be more explicit in relation to the holistic interpretation of environmental issues [44] and need to motivate training in environmental education for teachers based on participatory educational approaches [44]. Other studies also show that environmental education and its ethical dimension are recognised, although only in a mono-teaching context and without occupying a central place in lesson plans [45].

A recent European report shows that issues that include science and ethics are not addressed very often during the first eight years of school and are rarer in the first cycle of basic education (1st to 4th grades, 4 to 10 years of age) [46]. The report also states that the emphasis given to philosophical, historical and social aspects of science is not uniformly widespread in Europe [46]. However, this report also highlights the importance of including social issues and the ethical consequences of scientific progress in secondary education, emphasising that when students are asked to explore moral dilemmas, explain their views on them or list the risks of technological progress for modern civilisation, overall levels of performance improve [46]. In another European report, it is mentioned that at all levels of education, there is a preference for decisions based primarily on moral and ethical issues, with this preference being more pronounced among those who have finished education aged 15 or under [47].

3.2. Study 2: Education for Ecoethics in the Training Offer of BG ITT and CTT and Training Needs Regarding Ecoethics

Given the importance of ITT in training future teachers to address environmental issues from an ethical perspective, the first part of this second study sought to understand whether and how environmental ethics is integrated into the BG ITT curricula. Therefore, the study plans for the BG ITT courses at the PHEIs in mainland Portugal, available online on the website of each institution, were consulted. According to the information provided by A3ES, only five of them had a master's programme in teaching biology and geology in the third cycle of basic education and in secondary education. Of the five IESPs, only three, PHEI2, PHEI3 and PHEI5 (Table 8) included subjects/contents that can be related to education for ecoethics.

Table 8. Content related to education for ecoethics in BG ITT courses at PHEIs in Portugal (n = 5).

Code	Scope (CU)	Subjects/Contents
PHEI2	D	Environmental and sustainable development education
PHEI3	D	Holistic view of the Earth system
	GE	Values and principles of geoethics
PHEI5	D	Environmental education
	D	Environmental education; school and the development of morals, values and ethical commitments
	D	Ethical behaviour and civic education; values and education; bioethics
	D	Ethical behaviour; geoethics

D: didactics, GE: general education.

Although there are CU with syllabi related to applied ethics (bioethics, geoethics) and environmental education, which may include ecoethics subjects, there is no clear specific reference to education for ecoethics in any of the syllabi of the ITT courses offered by PHEIs, as shown in Table 8, making it difficult to see, in concrete terms, if and how ecoethics is actually approached, leading us to believe that the approach to ecoethics issues in the classroom may depend to a large extent on each teacher. This information seems to justify the teachers' opinions, with some of them feeling that their training in ecoethics is often insufficient to enable them to promote the (re)construction of environmental knowledge and values in their students [24].

Equally important is the training that in-service teachers receive throughout their professional careers—CTT—as it provides information on the knowledge provided in this context in ecoethics. Thus, with regard to the CTT in BG, which incorporates subjects/contents related to education in ecoethics in its study plans, the training offers of the 24 PHEIs in mainland Portugal considered above were also consulted with regard to master's degrees, postgraduate courses and short courses. The information provided online by their websites was taken into account, and Table 9 summarises the type and scope of the courses, as well as the subjects covered. PHEI1, PHEI2, PHEI4, PHEI6, PHEI7, PHEI8, PHEI9, PHEI11, PHEI12, PHEI13, PHEI15, PHEI17, PHEI18, PHEI19, PHEI20, PHEI21, PHEI22, PHEI23 and PHEI24 had no training subjects/contents that clearly included ecoethics-related subjects in their syllabi.

Table 9. Content related to education in ecoethics in BG CTT courses at PHEIs in Portugal (n = 24).

Code	Type | Scope (Course)	Scope (CU)	Subjects/Contents
PHEI3	M | E, Ec	B, E	Environmental awareness; pedagogy for connecting with nature and its importance in SD education; environmental ethics
PHEI5	M | A, E	P, E	Conceptions of nature and theories of the human—environment relationship; philosophical issues: intrinsic value, rights of entities, responsibility towards future generations
PHEI10	M | P, A	P	Contemporary environmental ethics; deep ecology; ecofeminism; ethics of environmental responsibility
	PG | EE, Ec	P	The ecological crisis; biotic and abiotic factors, ecological and ethological aspects; notions: nature, the environment, landscape, the environment and natural resources
		E	Ecological, anthropological, ethological and ethical perspectives on sustainability
		E	History of environmental awareness, relationship with environmental education, formal and non-formal; environmental education and its relationship with ethical, conceptual, and methodological bases
		E	The ecological crisis and activism; ethics of life, animal welfare and environmental stewardship
	PG | EE	B	Environmental and climate crisis
		B	Human—nature relationship; ecoethics, environmental ethics, animal ethics; deep ecology, biospheric egalitarianism
PHEI14	M | EE	Ed	Environmental ethics: foundations, paradigms and perspectives; ecological thinking; ideology and praxis
PHEI16	M | T, E	LS	Environmental education to raise awareness of nature conservation

Type of course: M—master's, PG—postgraduate. Scope of course: A—anthropology, E—environment, Ec—ecology, EE—environmental education, P—philosophy, T—tourism. Scope of CU: B—biology, E—environment, P—philosophy, Ed—education, LS—life sciences.

Looking at Table 9, there are only seven CTT courses available at national level that specifically include the area of ecoethics and/or related subjects. Despite the low number of courses, the majority of those that include the subject seem to go into it in some depth, insofar as they address its emergence, the foundations and some modalities of environmental ethics, reflecting on the relationship between human beings and the

natural environment. Even so, the level of depth of this approach may depend, in part, on each teacher.

Additionally, in the second part of this study, it was considered pertinent to question in-service teachers in order to obtain their perception of their training needs in ecoethics. To achieve the proposed aim in the second part of this study, BG teachers were firstly asked to answer a closed-ended question regarding their ITT, specifically, if issues related to ecoethics were addressed. As a result of data analysis, according to Table 10, it appears that the majority of teachers (50.2%) said that issues related to ecoethics were not addressed in their ITT, and 27% said they were not sure about that. In the latter case, the reason could be the advanced age of the respondents, whose initial training took place many years ago. Only 22.9% of the participants said that they had dealt with issues related to ecoethics in their ITT.

Table 10. Approach to issues related to ecoethics in BG ITT (n = 293).

In Your Initial Teacher Training, Were Issues Related to Ecoethics Addressed?	f	%
Yes	67	22.9
No	147	50.2
I am not sure	79	27.0

It is important to emphasise here that the ITT currently provided by Portuguese universities is governed by the post-Bologna process and the respondent sample is made up mostly of teachers who attended the pre-Bologna ITT, as shown in Table 3. This means that it is not possible to establish a relationship between the ITT currently offered in BG ITT courses with the ITT received by the teachers in the sample. This aspect also makes it difficult to establish a relationship between the ITT currently provided and the training needs felt by in-service teachers who attended an ITT course many years ago that is different from the current one. Even so, the information obtained from this study could help to improve the current initial training, as it helps to improve the programmes and contents of ITT courses, not least because, as Table 8 shows, BG ITT currently provided is neither clear nor solid in terms of addressing issues related to ecoethics.

With regard to the group of teachers who mentioned that they had dealt with ecoethics issues in their ITT (n = 67), the majority (86.6%) said that these issues were dealt with in the context of ecology and the environment (Table 11), giving specific examples of subjects in which they had dealt with the issue.

Table 11. Scope of the ecoethics-related subjects covered in BG ITT (n = 67).

Scope of Issues Related to Ecoethics Were Addressed in Your Initial Teacher Training	f	%
Ecology and environment	58	86.6
Geology	14	20.9
Biology	7	10.4
Philosophy and ethics	2	3.0
Ecoeconomics	1	1.5
Does not answer/Does not remember	14	20.9

Below are some illustrative examples of the teachers' responses, who mentioned examples of subjects in the field of ecology and the environment where ecoethics was covered in their ITT:

> (Inadvertent introduction) of invasive species and their consequences; pollution. [Teacher 129]

> Especially issues related to oil spills and intensive agriculture and soil erosion. [Teacher 221]

When asked how these subjects were covered in their ITT, most of the teachers mentioned that it was through oral presentations (43.3%) and field activities/study visits (31.3%), as can be seen in Table 12. Curiously, only 16.4% of teachers mentioned collaborative work as the preferred approach in their ITT when dealing with these issues, a curiously low percentage given that this is an active methodology that promotes the students' teaching and learning process [48]. It should also be emphasised that the use of practical activities was, strangely, the least mentioned (3.0%) by teachers. Given that, in addition to field activities, this would be an appropriate approach to promoting ecoethics education. This may be an interesting aspect to clarify/deepen by carrying out interview surveys with BG teachers.

Table 12. How topics related to ecoethics were covered in BG ITT (n = 67).

How Issues Related to Ecoethics Were Approached	f	%
Group work	11	16.4
Research work	3	4.5
Oral presentation	29	43.3
Field activities/study visit	21	31.3
Exploration of textual documents	7	10.4
Discussion	8	11.9
Multimedia visualisation and exploration	5	7.5
Practical activities	2	3.0
Does not answer/Does not remember	12	17.9

Below are some illustrative examples of the two most representative categories, namely 'Oral presentation':

Expository lessons with the use of images. [Teacher 69]

Essentially in a classroom context with exposure to subject matter. [Teacher 79]

As well as 'Field activities/study visit':

These subjects were covered in situ, through a study visit to a mining operation. [Teacher 20]

Essentially in study visits to situations/places of anthropic exploitation of natural resources with an environmental impact. [Teacher 104]

Regarding the approach to ecoethics in ITT, a question addressed to the entire sample (293), the majority of teachers (97.6%) believe that ecoethics should be part of BG ITT, while a minority (2.4%) are of the opposite opinion (Table 13).

Table 13. Teachers' opinion on the approach to ecoethics issues in BG ITT (n = 293).

In Your Opinion, Should Ecoethics Be Addressed in Initial Training Courses for BG Teachers?	f	%
Yes	286	97.6
No	7	2.4
Total	293	100.0

When asked to justify their position on the previous question, as can be seen in the following table (Table 14), the teachers who mentioned that ecoethics should be covered in the ITT for BG teachers were divided between the fact that education for ecoethics plays a role in training teachers to approach the subject (37.8%) both conceptually and methodologically, and the fact that it promotes knowledge on ecoethics issues, which are important in helping to improve the state of the planet (37.4%).

Table 14. Teachers' reasons for agreeing with the approach to topics related to ecoethics in BG ITT (n = 286).

Reasons	f	%
Enables the teacher to address the topic	108	37.8
Motivates the teacher in his role as a potential agent of change	41	14.3
Promotes knowledge in ecoethics to improve the state of the planet	107	37.4
Does not answer	55	19.2

Below are the most illustrative examples of the two most representative reasons. The first reason was 'Enables the teacher to approach the subject':

> It is a crucial topic for the curriculum of future generations, and it is therefore essential that teachers are well prepared to accompany and support students in developing these skills. [Teacher 19]

> It turns out to be a way of making future teachers aware of this issue and equipping them with pedagogical tools to explore it in an informed way. [Teacher 20]

The second reason was 'Promotes knowledge on ecoethics issues that help improve the state of the planet':

> A subject that is particularly pressing today in order to create a keen environmental awareness among teachers and students. [Teacher 16]

> We are all responsible for the ecological balance on which the continuity of life on Earth as we know it depends. If we do not act together in this direction, it will be difficult for the Earth to maintain the conditions necessary for the existence of life. [Teacher 43]

The importance given to environmental ethics education is supported by one study, [49], although the participants were pre-service teachers instead of in-service teachers. The participants reinforced the importance of environmental ethics, mentioning that otherwise it would not be possible to meet the needs of future generations, as well as the fact that they consider this topic crucial for pointing out behaviours that are good for the environment, while avoiding bad ones [49].

On the other hand, of the seven teachers who said that ecoethics should not be covered in the ITT for BG teachers, three of them justified it on the grounds that they consider ecoethics to be part of any teacher's general culture, another three argued that ecoethics should not be dealt with separately, considering that it is a topic that covers the entire science curriculum, and finally, one of the seven contended that ecoethics should only be covered in the CTT.

With regard to the CTT on ecoethics-related issues, 90.8% of the teachers said they had not undergone any CTT in this area in the last three years and only 9.2% of the teachers said they had undergone continuing training in this area (Table 15).

Table 15. BG teachers' attendance at CTT courses on ecoethics issues (n = 293).

In the Last 3 Years, Did You Do Any Ongoing Training in the Field of Ecoethics?	f	%
Yes	27	9.2
No	266	90.8
Total	293	100.0

It is important to note here that the current in-service teachers are the ones who regularly seek CTT courses, which makes it possible to relate their expressed lack of training in ecoethics (Table 15) and the limited or even inexistent training in ecoethics seen in the first part of this study (Table 9).

This lack of training can be seen in other studies [50,51], where the majority of respondents have no training in environmental education in general and in environmental ethics in particular. This leads the author of the study to conclude that most secondary school teachers in public schools have insufficient training in environmental education [50].

When asked to indicate the continuing training course in the field of ecoethics that the 27 teachers mentioned they had taken, the most frequently mentioned area was environmental education for sustainability. However, it is important to note that of the 27 teachers who mentioned that they had taken CTT in matters related to ecoethics, only one specifically mentioned environmental ethics as one of the topics covered in that training course, making it difficult to see whether the remaining 26 teachers had actually undertaken any CTT in the field of ecoethics. Furthermore, it was not possible to see the content/subjects covered and how the topic of environmental ethics was addressed in the continuing education programme of the only teacher who mentioned it.

Finally, according to Table 16, the teachers who mentioned having attended CTT courses in the field of ecoethics all said they had done so because they were interested in the subject (100%), and just over a quarter because they needed training in the area (25.9%).

Table 16. BG teachers' reasons for attending the CTT course in ecoethics (n = 27).

Reasons	f	%
Need for credits	6	22.2
Need for training in the field	7	25.9
Interest in the topic	27	100.0

Although the lowest percentage (22.2%) of BG teachers attended the CTT course for the reason 'need for credits', this is one of the reasons why teachers most often seek out CTT courses, given that in Portugal it is one of the requirements for teachers to progress in their teaching career.

The results obtained in this second study are in line with some of the results obtained from other studies. With regard to the training needs in ecoethics education felt by teachers, they considered the following: their training in ecoethics was often insufficient for them to be able to promote the (re)construction of environmental knowledge and values in their students [24]; awareness of ecoethics increases with the frequency of ecoethics training [25]; the quality of their ecoethics training was often inadequate [22] and needed to be improved [26,27]; the approach to controversial issues is pedagogically problematic because the authority of the teacher as a specialist in the subject is often challenged, and they consider it necessary to approach these topics in a different methodological way to that often adopted by teachers [21].

Given the above, teachers need more and better tools to teach issues related to ecoethics. Other studies go in the same direction [27,51–53], emphasising the importance of sensitising teachers to the topic. In this sense, there seems to be a need to develop a programme for teachers at the initial teacher training level, so that teachers can be aware of the ethical aspect of environmental education [51].

4. Conclusions

The fundamental ethical issue of the 21st century consists of rethinking the foundations of the multiple ways in which human beings act, as these have become a threat to life and the quality of life on earth. Environmental ethics is inseparable from environmental pedagogy, carrying the values of a renewed society. A responsible citizenship is tasked with training individuals who can address the environmental challenges resulting from the global environmental crisis. Thus, science teaching in general, and biology and geology teaching in particular, can contribute to solving these problems by promoting the ability of both teachers and students to reflect on the human–environment relationship, motivating the adoption of behaviours and policies in favour of the environment. A first focus can be centred on teacher training, which will then be reflected in their students. Therefore,

the main results of this research, which is made up of two studies, show the following: on one hand, issues related to education for ecoethics are not emphasised in most of the guiding documents for BG teachers' teaching practice, appearing more prominently in Environmental Education Guidelines for Sustainability (doc. C1) and in Development Education Guidelines (doc. C2), showing that, in general, they do not provide sufficient guidance on how to educate for ecoethics. On the other hand, it is not clear whether there is any training on ecoethics in BG ITT courses, and there are limited training offers on the subject in CTT courses. The majority of teachers who took part in this research revealed that they had not dealt with issues related to ecoethics in their ITT or CTT, expressing a need for training in this area. In short, ecoethics is not given significant weight either in the teaching practice guiding documents or in their ITT and CTT. By adding up the respective training needs felt by the teachers, it is possible to conclude that there is therefore no call for an environmental rationality not only in their own training as teachers, but also in the training of the generations that will be called upon to make environmental decisions in the future. Some suggestions on how teachers' training processes could be improved are as follows:

- Regarding the guiding documents for BG subjects:
  - Revision of the guiding documents to clarify and deepen issues related to ecoethics, its importance and its relationship with biology and geology subjects. This revision is especially relevant, as BG teachers will feel the need to seek further CTT in this subject if it is included in the documents that regulate what they should teach their students. This could also influence the training content covered in ITT courses.
  - Specification of the ecoethics content that should be included in the guidance documents, as well as appropriate teaching strategies.
  - Development of a reference for the implementation of good practices in the field of education for ecoethics, aimed at ITT and CTT, providing more concise and articulated guidelines bridging the gap between the two types of training received.
- Regarding BG ITT:
  - Integration of ecoethics content in biology and geology curricular units or creation of an environmental education curricular unit, which includes ecoethics-related subjects.
  - Inclusion of appropriate and effective methodologies in didactic curricular units for teaching topics related to ecoethics, namely, ABRP, roleplaying and debate.
  - Articulation of the training contents with the contents of the guiding documents in the field of ecoethics.
- Regarding BG CTT:
  - Increasing training offers for science teachers on ecoethics issues.
  - Ensuring that the training offers (including both theoretical and practical components) should be attractive and providing them with knowledge that they find useful for their teaching practice, so that teachers feel inclined to attend. This is especially important since teachers can choose the CTT they want to attend.
  - Training in ecoethics should be accredited by an accredited institution because, in addition to greater training value, teachers need training credits to progress in their professional careers, increasing the likelihood that they will attend.
  - Articulation of the training contents with the contents of the guiding documents in the field of ecoethics.

Insofar as environmental problems are closely related to very important scientific issues with social relevance, raising ethical questions, schools in general and teachers in particular must be able to address them in a way that facilitates students' learning and their formation as individuals who are both aware of and critically engaged with the world to which they belong. Ever more, education in ecoethics is an important resource for the training and professional development of teachers in this area so that they can

contribute to the effective and meaningful education of their students, fostering awareness of environmental issues and contributing to the personal and collective formation of environmental awareness. Given the importance that ecoethics has in the context of science teaching, the results of this research have both scientific and social relevance for the context of teacher training, specifically for BG teacher trainers, as well as for BG teacher training institutions, making it possible to create both initial and continuing teacher training courses. However, in order to be able to draw more in-depth conclusions about the knowledge and opinions of in-service BG teachers on this topic, interviews would be desirable as a complement. Thus, further studies should be carried out in order to deepen the results obtained in the present study, as well as others that assess teachers' knowledge on the subject, to enable teachers to address it in their teaching practices.

Given the current state of environmental crisis, the concept of citizenship has broadened and is now understood broadly as planetary citizenship; that is, as integrating the environmental dimension into citizens' rights and duties. This research focuses precisely on the pedagogy for a citizenship committed to the planet, emphasising the urgent need to train students and teachers in a way that combines ecological literacy with environmentally correct action as a way of responding to these challenges, thus contributing to the formation of a responsible conscience that is engaged with the planet and future humanity.

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