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Education for Environmental Citizenship in Pre-Service Teachers: Potentialities and Limitations of a Pedagogical Approach Applied at a Distance

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Abstract: The 21st century can be defined as the era of "global environmental crisis". The education for environmental citizenship pedagogical approach is a strategy with potentialities for meeting the challenge of a sustainable future. This case study sought to evaluate the effect of an ecology course, organized according to the education for environmental citizenship pedagogical approach and supported by Web 2.0 tools, on a group of Portuguese female pre-service teachers (n = 21). No previous studies resorted to this approach to organize courses for initial teacher training or used Web 2.0 to support its implementation. Thorough semi-structured interviews and the analysis of the resources produced, it was found that the pre-service teachers considered the approach to be structured, interesting and motivating, with positive impacts on the development of several attributes of an environmental citizen. The experience with the pedagogical approach fostered the didactic knowledge of the pre-service teachers, regarding how to implement activities of this nature. The Web 2.0 tools used to support the implementation of the pedagogical approach—Facebook and MindMeister—were positively appreciated by the participants. However, some identified difficulties suggest the necessity of using other platforms more frequented by youngsters. The distance-learning context imposed by the COVID-19 pandemic did not function as a big barrier to the pedagogical approach's implementation. Suggestions for future research are presented, built on the limitations of this study.

Keywords: education for environmental citizenship; pre-service teacher training; education for sustainable development; education for environmental citizenship pedagogical approach; Web 2.0

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1. Introduction

The 21st century can be defined as an era of "global environmental crisis", in which a myriad of environmental and social issues challenge the ability of societies to guarantee a sustainable future. These global problems are highly complex, inter-related and interdependent, and, for this reason, require new approaches for understanding and conceptualising people's relationships with the natural world [1]. This context requires changes to the behaviour of individuals and organisations, to support sustainable development [2]. Framed by this context, the education for environmental citizenship (EEC) pedagogical approach is like a tool with potentialities for promoting an education which cultivates the knowledge, competences, values and attitudes that are necessary for an environmental citizen, making it possible for them to act and participate as agents of change in society. The objective of this training for individual and collective action is to resolve current environmental problems and to prevent new environmental problems, in order to achieve sustainability based on a healthy relationship with nature [3]. UNESCO [4] also recognises that people have to change the ways in which they think and act to achieve a sustainable future, and argues in favour of defending education for sustainable development (ESD).

An education with this orientation would include the key issues of sustainable development in the education system, supported by pillars consisting of the promotion of critical thought, collaborative decision making and the training of students to live responsibly and to face complex global challenges [4]. This study emerged within that framework and was conducted with future infant and primary school teachers, because educators in general are powerful agents for change if they train young people with the knowledge and competences that are necessary for pursuing the objectives of sustainable development [4]. At the same time, it is known that for "teachers to be prepared to facilitate ESD, they must develop sustainability key competencies (including knowledge, skills, attitudes, values, motivation, and commitment)" during their initial and continuous training [4] (p. 51).

The objective of this intervention was to answer to the call made by Georgiu, Hadjichambis and Hadjichambi [5] regarding the necessity to test the EEC pedagogical approach with pre-service teachers in the context of future teachers' training initiatives duly designed for this purpose. So, this case study tested the effect of an ecology course, organized according to the EEC pedagogical approach, supported by Web 2.0 tools and conducted at a distance (during the pandemic), on a group of Portuguese pre-service teachers. No previous studies resorted to this pedagogical approach to organize courses for initial teacher training [3,5] or used Web 2.0 to support this approach's implementation. This is an original contribution to the scholarship of this study.

1.1. Educating for Sustainability through Action

Education is a central priority of UNESCO because it is a fundamental human right, and the foundation for peace and for the progress of sustainable development (SD). Teachers are key actors for facilitating the adoption of sustainable lifestyles by pupils [3,4]. Educational contexts can help young people to understand the choices that SD requires and motivate them to make changes, both in themselves and in society. For it to be possible to promote this reorientation in the young people with whom they conduct their activities, teachers should be made responsible and given the competencies to implement this transition. This reinforcement of the competencies of teachers is vital for the achievement of another of UNESCO's priority areas [6]—empowering and mobilising young people. It is therefore the young people of today and of the next generations who will have to face the consequences of this transition. It is a group which is increasingly seeking to "have a voice" and become involved in subjects such as the climate crisis through creative solutions to respond to the challenges of sustainability. This group requires particular attention in the sense of their involvement and mobilisation for this environmental cause, which is the cause of all citizens. At the same time, this empowerment and mobilisation make it possible to develop actions within the community. This is another area for the priority action of UNESCO [6]—accelerating action on a local scale. The choices of individuals are made at a local level, in their daily life, and may mean actions and choices which could be favourable for SD. In this way, it is fundamental to contribute towards co-operation between schools and communities in order for knowledge and practices to respond to local priorities.

Even so, despite the alerts and signs that we see today telling us that we are going beyond the boundaries of what can sustain the planet, individuals continue to have attitudes and behaviours which are harmful to the planet. Thus, we can ask ourselves about what other options are available, to try to make people change their attitudes and behaviour. This is a great challenge which education for sustainable development aims to meet, particularly through education oriented towards action. Education oriented towards an action is part of this. Thus, education for sustainable development for 2030 (SSD) [6] contributes to the OSDs to "ensure access to inclusive equitable quality education, and to promote lifelong learning opportunities for all" (p. 2), as well as for all other OSDs, providing education which is focused on responsibility for the future. ESD is a key element for good-quality education, offering the development of transverse competences in the cognitive, socio-emotional and behavioural dimensions of learning that are useful in all areas of education [7].

Systems of education should not be limited to preparing young people for the world of work and should foster the competences necessary for them to become active, responsible and committed citizens. To act, it is necessary to be able to define an objective and decide on the actions necessary for achieving this objective. In this way, educators play an important role in this process [6]. The "Education 2030" project of the OECD [6] defined three categories of transformative competences, whose aim is to respond to the increasing need to train young people who participate more, and who are responsible and aware of reality. These skills are (a) creating new values; (b) reconciling tensions and dilemmas; and (c) assuming responsibility (p. 5). The category of creating new values concerns the need for us to be creative, to picture new ways of thinking and living, and new economic and social models. Innovation comes from collective work based on the ability to adapt, as well as creativity and open-mindedness. For reconciling tensions and dilemmas, young people should learn to deal with tensions and dilemmas, conciliating equity, freedom, autonomy and community within a democratic process. Individuals should be able to reflect in a more general and systemic way, and to identify possible interconnections. The dimension of taking responsibility means that the future consequences of their actions should be taken into consideration. They should be able to assess risks and benefits, and to assume responsibility for the results of their work.

For Hodson [8], a science curriculum oriented towards action is an essential component of education for responsible citizenship. In his opinion, if pupils are encouraged to act now (in a school context), the probability of their becoming active citizens in the future will be greater. Thus, pedagogical practices should be provided that lead them to act within the community and to give examples of successful actions. According to Alsop and Bencze [9], education for activism is part of education for citizenship, and cannot be worked on outside the context in which they live. For a citizen to act in a responsible way, young people should be trained to be informed and critical (scientifically literate), socially connected, to have respect for diversity and to be ethically responsible and involved [4].

During the last two decades, various different studies have shown the potentialities of some pedagogical approaches for preparing pupils and teachers for activism initiatives related to socio-environmental problems. In these projects, activism is recognised as collective action for democratic resolution and is based on socio-scientific and socio-environmental problems [8–11].

In the study that Piassi et al. [12] conducted on the dissemination programme called "Science Stand"—which seeks to integrate scientific and technological activism through educational practices in schools, marginalised communities and public spaces in the region of São Paulo—it was found that the university students who participated became agents of mobilisation (activists) in the communities where they worked or visited. This intervention in the community impacted the ways of seeing and acting in the world of university volunteers, not only by changing their habits and attitudes in relation to environmental problematics, but also in relation to issues of gender in science and social inequality. The activities which were created led students to take responsibility for sharing their knowledge with others. The authors also concluded that the students went through a process of inner transformation as a result of the process of attempting to transform society. In the area of the same "Science Stand" programme, the vertical garden project is an initiative which addresses socio-ecological injustice and serves as a solution for people without adequate access to good-quality scientific education [13]. The 23 future teachers involved in the project acquired a broader vision of sustainability, which was not limited to understanding the necessities of people, but also included the necessities of other forms of life and their habitats. In this way, the young people experienced transformative learning that allowed them to gain a greater appreciation of science and the natural environment, and to broaden their vision of human interconnection with all forms of life.

Zoras and Bencze [14] conducted a study with pupils from a secondary school science class, using different types of technology and social media to work on the CTSA issues and to learn strategies for activism in their lives. They observed that the pupils had a better

understanding of these subjects and assumed strategies for activism. The fact that they experienced these approaches, which involved the identification of a problem, and even took action against the problem, made the pupils feel ready to research and take action against a problem. The use of social media was derived from its extensive use in modern societies, and can not only provide information, but also mobilise and lead other people to join a cause. However, the authors recognise a disadvantage associated with the fact that it is easy for users to simply put a "like" on a page or even share it without having any effective involvement, and these cases do not produce real change. One of the social networks used was Facebook™, which served as a means of sharing the pupils' actions, based on research, of showing problematics an encouraging more ecological lifestyles, posting information in different formats, such as videos. This network makes it possible to establish connections between people, which allowed the pupils to create a network of friends and other people (to reach new audiences) with similar ideas on the subjects addressed. The pupils appreciated the work that was conducted with the inclusion of social media in the projects, particularly their adaptation of school objectives, embracing the role of "teaching" others about the subject they were working on, and also considered the resource to be an efficient way to reach more people.

A recent study conducted by Scherman, Valenzuela and Rivera [15] shows that social media, such as Facebook and Twitter, are positively associated with participation in environmental protests. Citizens who spend more time on social media platforms are more likely to participate in such protests. Other research has revealed the potential of social media to encourage grassroots environmental participation, spreading environmental knowledge, promoting interactions between people with different ideas and mobilizing citizens to participate in pro-environmental activities [16,17].

According to another study [18], the discussions about environmental issues—e.g., global warming—held by students in online communities are characterised by confrontation and challenging actions, expressed with critical generative and counter-argument moves, allowing for the negotiation and the debate of the personal and public interests, values and views of the participants. These conversations in an online community can be important for learning about and taking a stand on environmental and sustainability issues [18]. This kind of environment allows for and stimulates the participation of all students, avoiding the limitations of some classroom environments where conversational hierarchies can be created, allowing few student voices to be heard, with the oral domination of the conversational space by the teacher [18]. So, in order to avoid these limitations and to plan and conduct participatory and pluralistic conversations, teachers can take into consideration students' everyday communicative and meaning-making experiences on social media [18].

Torres-Harding et al. [19] found that the involvement of pupils in projects for social activism to promote the civic participation, self-efficacy and positive development of the pupils allows small children to successfully play a significant part in projects for activism, which begin in the school. The children in basic education (seventh year) who participated in the study showed great enthusiasm, empowerment and a sense of community. The children acquired knowledge and developed competences related to social change; they had knowledge about the measures that could be taken to promote change, as well as actions to be taken in the future. The data obtained by the authors suggest that children of elementary (primary) school age are able to develop socio-political or critical awareness. One critical component for the success of these projects is the support that the children/pupils may receive to help achieve them. In this study, the pupils could count on the adults of the community, teachers and persons responsible for the school, who were sensitive to their needs.

Since 2010, the project called "We Act—Promoting Collective Activism on Socio-Scientific Issues" has developed, implemented and studied material, methodologies and approaches for the support of teachers and pupils who are taking responsible action on socio-scientific issues [20]. The series of initiatives developed has had a positive impact

on the pupils who conducted them, particularly the reinforcement of their perception of their own competences for activism and the duty to participate in collective action, based on the democratic resolution of problems. Overall, the initiatives held in the "We Act" project made the pupils feel more capable and empowered to (1) influence the decisions of colleagues and citizens in general about social problems related to science, technology and the environment, and (2) begin, together with their colleagues, to create initiatives which contribute to the resolution of the social problems that concern them [20]. The activism initiatives involving Web 2.0 tools—especially those which permit co-operative communication through social networks—have represented an extremely powerful way for citizens to express and disseminate their opinions independently, with a strong impact on the cultural/social/political empowerment of citizens [14].

In this same project, various studies conducted during pre-service teacher training made it possible to understand the potentialities, as well as some of the difficulties, which could arise with proposals oriented for action. In terms of potentialities, the important potentialities are those which focus on an understanding of the complexity of the environmental problems being analysed, as well as critical thought, communication and training for action [21,22]. The difficulties were essentially due to a lack of familiarity with the approaches, which were oriented for action in the community. A lack of experience with strategies which could lead to transformative action, oriented by environmental values, can condition the adoption of practices with these characteristics by the teachers, even if they recognise all of their potentialities and advantages for the education of young people [22]. This situation brings us to the need for a more effective integration of practices that are oriented for action in the training of teachers and educators.

1.2. The Pedagogical Approach of Education for Environmental Citizenship

Education for environmental citizenship (EEC) is a type of education that cultivates the knowledge, capacities, values, attitudes and competences that are necessary for an environmental citizen to be able to act and participate in society [3]. Civic participation is fundamental for education for environmental citizenship, which allows pupils to develop the abilities and competences that are necessary for taking part in actions within society [3]. This is participation in democratic processes as a response to the imperious necessity of sustainability.

Education for environmental citizenship is framed by various different pedagogical approaches, among which, for example, are problem-based learning, location-based learning and inquiry-based learning, focused on socio-scientific issues. The EEC pedagogical approach is also based on other types of education such as "Environmental Education, Education for Sustainable Development, Scientific Education and Education for Citizenship" [3] (p. 249). This pedagogical approach, presented by Hadjichambis and Paraskeva-Hadjichambi [3], is an integrated and comprehensive tool that includes a sequence of stages and steps that are designed to promote EEC.

The starting point of this approach is a local or global environmental problem arising from the interests and associated concerns of the students, and about which they feel that they should do something, or may play an important role, being able to act as agents of change. A way to stimulate pupils could be through the use of information in the form of photographs, videos or news.

The education for environmental citizenship pedagogical approach includes six stages (Table 1).

Table 1. Stages of the pedagogical approach to education for environmental citizenship.

Stages	Name of the Stages of the Pedagogical Approach to Education for Environmental Citizenship
1	Inquiry
2	Action Planning
3	Critical and Active Engagement and Civic Participation
4	Networking and Sharing in Scales—local, national, global
5	Sustained Environmental and Social Change
6	Evaluation and Reflection

Each of these stages includes different moments, which do not have to follow a strict linear sequence and can begin with the stage that is best suited to the case study. The inquiry stage is sub-divided into five phases: (a) data collection and analysis—during which the students collect and analyse the data necessary for exploring the environmental problem; (b) structural causes—the structural causes of the problem should be identified, for example, environmental laws or procedures for the protection of nature which are inefficient; (c) inter- and intragenerational injustice—cases of generational and intragenerational injustice are examined which are relevant to the environmental problem in question. For example, the students can observe the accumulation of wealth for some entrepreneurs (intragenerational injustice) or future generations are deprived of some eco-systemic services (intergenerational injustice); (d) the clarification of fundamental values—raising fundamental questions about the values underlying the environmental problem. For example, the values that support the positions taken by various interest groups, called stakeholders (for example, entrepreneurs, students, environmentalists, etc.); and (e) open-air activities can be included, which give students the sensation of efficiency in relation to the environment, and may increase their commitment and feeling of relevance.

In relation to the action-planning stage, during which the pupils are invited to plan individual and collective actions in the private and public spheres, the moments contemplated are (a) the identification of the interested parties (stakeholders) who are relevant for the environmental problem. For a local environmental problem, the stakeholders can be entrepreneurs, ecologists, students, government, neighbours; (b) the mapping of the controversy—for mapping positive and negative arguments, the inter-relations of the stakeholders are crucial for understanding the complexity of the environmental problem; (c) alternative solutions—register and examine possible alternative solutions for the environmental problem; (d) investigate structural resistance—they can investigate the structural resistance that may challenge a proposal. Some examples include the resistance of the system, inflexible laws, the conflict of interests, interference and curriculums being full in the case of schools; and (e) risk assessment—the risks should be identified.

The stage of critical and active engagement and civic participation involves (a) decision making—decisions are taken with alternative solutions in mind. Contacts can be made with scientists, environmental or political organisations and other parties that are interested in presenting their opinions on the environmental problem being studied; (b) exercising environmental rights and duties—verifying whether a certain project assures the rights and duties of citizens. Every citizen has the right to access and participate in public consultation processes for the evaluation of environmental impacts; (c) actions in the community—including individual and collective actions in the public and private spheres. Some examples are organising a campaign and making a donation, protecting the environment, becoming a volunteer, publishing an article in a local newspaper or participating in radio and TV programmes about the problem of the environment. Organising or participating in a public debate may be another possibility (for an audience which is more adult); and (d) student activism—this can involve information campaigns for colleagues, families, communities and the general public, and organising and participating in demonstrations.

Networking and sharing in scales includes the organisation of local or national networks of students, scientists, volunteers, activists and politicians. It is a way to influence and encourage local communities to actively understand the importance of the environmental problem being studied. Social media, social networks and other technological applications can have a great deal of influence.

The stage of environmental action and social change makes it possible to support and improve previous actions, for example, by keeping the subject in the news and adopting new measures and actions for reinforcement. Although the moment of recompense is optional, thanking those who helped with actions (for example, students, volunteers, supporters) is recommended.

Finally, the evaluation and reflection stage is for students to evaluate and be evaluated in terms of the successes of the actions undertaken.

This pedagogical approach makes it possible to form important partnerships between the school, science and society, bringing down the "walls" which often isolate schools from their community. This work methodology should also be incorporated into different school curriculums in such a way that it can be differentiated by the different levels of school education, ranging from infancy to higher education [3].

The EEC pedagogical approach has been used in secondary schools' classes from different countries—Cyprus, Sweden, Belgium—with some identified effects mainly in the behavioural rather than the cognitive domain. These interventions had a significant impact on the development of students' action competence [23], which is an important EC attribute. In the Cypriot intervention, there was a significant improvement in the students' intention to talk to others about environmental issues and to participate in online discussion forums about environmental issues [24].

While several studies have investigated the impact of university degrees on some of the EC attributes [25,26] and the importance of an effective integration of practices oriented towards the promotion of action competences regarding environmental problems, in the initial training of education professionals, to enable them to implement these practices later in their own contexts of intervention [22], no previous studies resorted to the EEC pedagogical approach to organize courses for initial teacher training. Georgiu, Hadjichambis and Hadjichambi [5] pointed out the necessity to test the EEC pedagogical approach with pre-service teachers in the context of future teachers' training initiatives duly designed for this purpose.

2. Methodology

The objective of the qualitative and interpretative case study, which oriented the research undertaken, was to test the effect of an ecology course organized according to the stages of the EEC pedagogical approach, supported by the Web 2.0 tools and conducted at a distance (during the pandemic), on a group of pre-service Portuguese teachers. The use of a case study came from the need to investigate a contemporary phenomenon in its real context, with clearly defined limits [27]. Our case study is centred on a class in the 1st year of the Teacher Training Course for Basic Education—consisting of 21 female students, with ages ranging between 18 and 51—who attended ecology classes during the 2019–2020 academic year, and who worked on a project framed by the education for environmental citizenship pedagogical approach. This year, it happened that only female students were attending this course. All the students agreed to participate in the case study.

This article analyses the results obtained through extensive semi-structured interviews and document analysis. The advantage of using interviews is that it is possible to gather descriptive data expressed in the language of the subjects themselves, which allows researchers to gain an idea about the way they interpret certain situations [28]. The semi-structured interviews also made it possible to obtain comparable data from the subjects [28]. The complementary nature of what was produced by the participants (analysis of Facebook pages—the social network selected by the students for implementing their actions) made it

possible to enrich the analysis and to find information which was useful for achieving the objective of the study [29].

The data content was analysed to organise the information being gathered and make it more comprehensible. A system of coding was created to organise the data and served as a means of classifying the descriptive data gathered and of considering the research issues and/or objectives [28–30].

Ethical issues were protected in this study. Informed consent was obtained from all participants and codes were used, with a capital letter representing the technique used to gather data, such as the letter E (standing for Entrevista in Portuguese—Interview in English), followed by a number according to the interview analysed (e.g., E1). This information was also complemented by the indication of the name of the problematic worked on by the groups to gain a better understanding of the answers given by the different members of each group, without revealing the identity of the future educators/teachers, which guaranteed both their anonymity and the confidentiality of the data [28].

This research took place during the pandemic caused by the new coronavirus, SARS-CoV-2, responsible for the COVID-19 disease. The confinement imposed during this study led to the adoption of extraordinary measures for teaching and learning, by adopting the modality of distance teaching.

2.1. Didactic Sequence Adopted According to the EEC Pedagogical Approach

The work proposed for the participants in the study was centred on the education for environmental citizenship pedagogical approach developed by Hadjichambis and Paraskeva-Hadjichambis [3] (Table 1). For this purpose, the future teachers organised themselves into work groups of between three and five members. The teacher gave the students the possibility of choosing a contemporary environmental problematic related to the Portuguese reality and about which they would like to learn more. The environmental problematics worked on by the groups were the construction of a new airport close to Lisbon, the exploration of lithium in the north of Portugal, deforestation and forest fires, the disappearance of bees and food wastage. Addressing these environmental issues made it possible to work on the learning objectives of the ecology curricular unit, such as (a) analysing and discussing the main environmental problems on our planet; (b) understanding the interactions between science, technology, society and the environment; (c) incorporating and disseminating the values of sustainable development, as well as information and education for sustainable development; (d) promoting a culture of citizenship and active civic participation, and stimulating practices which promote sustainable development; and (e) promoting the capacity for critical thinking, decision making and creative thinking that are essential for the identification, analysis and resolution of ecological problems.

Stages of the Education for Environmental Citizenship Pedagogical Approach

The ecology course—lasting one semester—was organised around the six stages of the EEC pedagogical approach: (a) inquiry; (b) planning actions; (c) civic participation; (d) networking; (e) sustainable action; and (f) evaluation.

The investigative activity involved the research and analysis of data from different information sources to gain an understanding of structural causes (e.g., environmental laws or procedures which are inefficient for protecting nature), situations of inter- and intragenerational injustice (identifying situations where wealth is accumulated by some entrepreneurs—intragenerational injustice—or situations which deprive future generations of some ecosystemic services—intergenerational injustice), according to the values defended by each stakeholder. These data allowed each group to focus their arguments on scientific evidence. Intergenerational injustice means "the justice between different generations, focusing on the necessity to take into account the needs of future generations. Intra-generational justice explains the issues of justice and injustice within one generation (mainly refers to current generations)" [3] (p. 246).

In the planning actions stage, individual and collective actions are planned in the public and private spheres. In this stage, each work group created a map of a controversy, considering the inter-relations, values and actions defended by the interested parties (stakeholders—e.g., environmentalists, students, the mayor, the company director, etc.). According to Venturini [31] (p. 796), "the cartography of controversies is a set of techniques to investigate public disputes especially, but not exclusively, around technoscientific issues" and "to make the intricacy of scientific debate readable for a larger public" [32] (p. 74). The objective of the students is thus to appropriate the controversy under study and to characterise its complexity, organising and representing the interaction of the social actors involved [33]. The cartography makes it possible to organise the information in the space and to categorise it, which makes it possible to characterise the complexity of the problematic under study [34].

Civic participation involves decision making, with a view to proposing alternative solutions and actions in the community—individual and collective action for the resolution of problems. Each work group participated in a Moodle forum to share and discuss opinions based on the environmental problematic under study.

The stage of working in networks consists of the organisation of local/national networks: the creation and promotion of a Facebook page by the students, to influence and encourage the community to understand the importance of the problem under analysis and to modify their behaviour. Some of the Facebook pages were helped through participation from people in the community who were interested in the problematic under analysis, as well as from the actual teacher of the curricular unit. The choice of Facebook, rather than any other social media platform available, was decided by the students and motivated by their previous personal experience with this platform. The students were entirely free to choose the social media platform they would like to use for their action initiatives.

Sustained action involved the promotion of the Facebook page for some weeks as a way to support and improve the activism initiative undertaken, with the internauts benefiting from more opportunities to extend their knowledge and share ideas.

The objective was for the students to evaluate the efficiency of the proposals presented in terms of resolving the environmental problem, using an evaluation questionnaire. The products created by the work groups were evaluated through the different stages (presentation stage 1, controversy map, a poster with alternative solutions, a discussion forum and a Facebook page).

3. Results and Discussion

Below is the presentation and discussion of the data obtained by analysing transcriptions of the semi-structured interviews, as well as the products (e.g., controversy maps and the Facebook page) created by the different work groups, after an action focused on the pedagogical approach of education for environmental citizenship, the objective of which was to evaluate the effect, on a group of Portuguese pre-service teachers, of an ecology course, conducted at a distance (during the pandemic) using the Web 2.0 tools and organized according to the EEC pedagogical approach. No previous studies resorted to this approach to organize courses for initial teacher training [5] or used Web 2.0 to support this approach's implementation. This is an original contribution to the scholarship of this study.

3.1. Evaluation of the Education for Environmental Citizenship Pedagogical Approach by the Pre-Service Teachers

The interviewees highlighted the way the approach is organised into stages and considered that this organisation made it possible to develop their knowledge of the problematics under study with what they discovered. The existence of various stages favoured a better comprehension of the subjects, given the sequential nature of the tasks associated with each moment. There were also affirmations which indicated that it was structured work, due to the interconnection between stages. At the same time, it helped to

avoid overloading the groups with the work to be undertaken because the study took place over time.

> "*At every (stage), there was a consistency and the stages were well structured (. . .) we progressed step by step with the problem*" (E13) (problematic of food wastage).

> "*The stages were all interconnected, to enable us to acquire knowledge and to know what knowledge we could apply*" (E9) (forest and fire problematic).

> "*It was dynamic. For me it was really good. The fact that we went through various stages, meant that we were not overloaded with work and that we absorbed information on the subject better*" (E11) (problematic—food wastage).

The stages of the approach appeared to have awoken the curiosity and interest in the work to be undertaken, showing itself at each moment to be a challenge to be overcome, which stimulated the groups to research more and more information.

> "*It was super-interesting. Speaking for myself, I'd say it was work that we really enjoyed doing. We wanted more and we were always looking for more information. One word for this approach is challenge. It's really challenging. It managed to challenge us*" (E5) (problematic—construction of the airport).

Another attribute of the EEC pedagogical approach which was identified by the participants in the study was its informative nature, because it allowed the various work groups access to information on different environmental problematics and helped them to gain an understanding of the complexity associated which each one. Also emphasised were the stimulation of thinking, the capacity for reflection and intervention promoted in the sense of raising the awareness of the community as facilitators of the knowledge built in the area of each problematic.

> "*Informative, mainly. It gave us a vision that we weren't expecting. Not only of my own problematic, but also many others that were worked on by my colleagues*" (E1) (problematic—save the bees).

> "*We were able to understand a great deal about different subjects. It allowed us to think, reflect and later intervene to help resolve the problem or make people see that they are doing themselves harm by wasting food, because on the one hand, they are harming the environment and, on the other hand, they spend money unnecessarily. While other people are going hungry, we were wasting food*" (E12) (problematic—food wastage).

In some cases, the reflection and knowledge developed through this pedagogical approach triggered the adoption of new behaviours, as in the case of the problematic related to the disappearance of bees, where strategies have been undertaken to contribute towards saving them: "me for example, at home I already fill bowls with water to put on the window sill outside." (E2) and "(. . .) at my grandmother's house. She likes flowers, and I have asked her to plant certain flowers that help the bees" (E2). These findings are consistent with those of other studies that have employed the EEC pedagogical approach with secondary students from various countries, all showing positive effects on the development of students' action competence [23,24].

Some of the interviewees considered the pedagogical approach to be complex and demanding. Its characteristics make it an approach that requires time, leading to the problematisation of the subjects and to a preparation of the information to be disseminated to the target audience, making it more demanding in the end. However, this requirement is not interpreted in a negative way by the students, who recognise the importance of each stage of the approach for a better understanding of the problems under study, as well as the fact that it involves differentiated stages with very specific objectives to foster an understanding of the complexity of the problems under analysis, the active participation of the groups and the raising of awareness among citizens.

> "*It's not demanding in a negative sense. We had various stages which were very important without a doubt. It was demanding because we wanted to do our best, and wanting to do our best meant that we lost out, but it wasn't losing as such. Much time was spent researching and organising everything we wanted, to achieve the best result possible. We looked at various references and then chose the one that was most adapted to the circumstances, to the target-audience, which was very important without a doubt*" (E6) (problematic—construction of the airport).

> "*I think it's a bit complex. But the teacher was always ready to help. She asked certain questions that we hadn't thought of. She taught us to always think a bit more*" (E15) (problematic—exploration of lithium).

Overall, different aspects were valued by the participants. The diversity of resources and of the activities proposed was one of the aspects emphasised, not only because different materials and strategies were used ("We used various materials, it was not just research." E13 | problematic—food wastage), but also for the activities themselves that were considered to be important:

> "*They were important for us to understand all the controversy around the problematic. In relation to the map and to the initial research*". (E8) (problematic—construction of the airport)

The active part played by the students in the construction of knowledge was emphasised by one of the participants. According to this future teacher, involvement in various different tasks, which ranged between the research, selection and organisation of the information in different phases, fosters more motivation to develop the work and, consequently, to learn in an active way.

> "*We play an active role. We are the ones who gather the data; we are the ones who have to see what is important or isn't. On the Internet, we have to see what is reliable and what isn't. This motivates us more because we are the ones who are doing the work and the research*" (E10) (problematic—food wastage).

However, during this active process, many participants felt that it was difficult to research information. According to the interviewees, one component that led to some difficulties was related to the selection of information researched (n = 10). Various reasons were presented, one of which was the quantity of information combined with the identification of contradictory information, which required a more rigorous and extensive search, to confirm the data obtained through the research. The distinction between reliable and false information was difficult for the groups.

> "*The part where we researched information was difficult. For example: when we wanted to find very specific data, statistics, we found a great deal of unreliable information. This part was a little difficult: to select the information that was most appropriate and genuine from the information that we found*" (E10) (problematic—food wastage).

> "*At the beginning, we found it difficult to select the information. It was a subject that was talked about a great deal. There was really a lot of information and we had to select only some of it*" (E6) (problematic—construction of the airport).

Another difficulty was to find current information from Portugal, and that required more thorough research. One respondent mentioned that they had to look for data in English about the problematic under study or use sources from Brazil, a country that has a great deal of information but, in both cases, the realities are different to ours. For this reason, it was accepted that they were not the sources which were the most appropriate for the environmental problem they were studying—the exploration of lithium in Portugal.

> "*I got to the point of saying that in Portugal, you find almost nothing apart from those reports. But then I actually started to research in English to see if I could find something and, in Brazil, for example, there is really a lot of stuff, really a lot of information, but then it doesn't seem to fit our reality either*" (E14) (problematic—exploration of lithium).

> "*At first, we wanted to find news that was current and most of what we found was older news*" (E15) (problematic—exploration of lithium).

Other potentiality identified by the pre-service teachers in their experience with the education for environmental citizenship pedagogical approach was related to the development of didactic knowledge, which the study participants foresee using in their future teaching (n = 5). This didactic experience enabled them to understand how to plan and organise activities of this nature and adapt them to a group and a level of education. In this way, in addition to constructing knowledge related to environmental problematics and forms of intervention in the community, it also fostered the didactic knowledge of these future teachers.

> "*I think it was important for us to work for our future as professionals. (. . .) To know how to work on these problematics with children*" (E4) (problematic—save the bees).

> "*Various stages brought new didactic discoveries and knowledge about different ways of conducting the same activity*" (E14) (problematic—exploration of lithium).

The affirmations of the participants made it possible to understand that the experience of the project could motivate these future professionals to include practices that are oriented towards sustainability and organised according to this pedagogical approach in their future professional activity. These data support the data obtained in previous studies conducted by Linhares and Reis [22], which showed the importance of an effective integration of practices oriented to education for environmental citizenship and for action in the initial training of education professionals to enable them to implement these practices later in their own contexts of intervention.

Another potentiality emphasised by the future teachers was the promotion of communication competences (n = 4). This educational experience involved various moments, which included the use of scientific language, situations of information sharing and discussion through the presentation of the results of the research conducted in the different stages of the EEC pedagogical approach, using diverse technological resources. The participants in the study valued the fact that they had worked this on competence, which they considered to be fundamental in their professional training:

> "*Communication is fundamental. As future teachers, we have to know how to talk to our pupils and so the more we work on this the better*" (E5) (problematic—construction of the airport).

> "*In terms of the confidence to show myself to a class, it is difficult at first, but then as we continue, we also develop these competences and it ends up being easier*" (E9) (problematic—forests and fires).

The construction of scientific knowledge is another potentiality of the work conducted that was indicated by the participants (n = 4). The interviewees recognised that, without this approach, they would not have understood what was involved in the sphere of environmental problematics, which they had the opportunity to explore.

> "*Yes, because if it wasn't for this, I would never have had the opportunity to really understand what this problematic was about*" (E1) (problematic—save the bees).

Different studies also indicate a deeper understanding of the problematics worked on, as well as the promotion of their capacity for communication through the practices of activism and environmental citizenship [14,18,20,22,35–38].

However, some respondents could not understand how knowledge built around a certain local environmental problematic would be important for their life. This situation shows a difficulty in establishing relationships between environmental problems at local and global levels. The explanations offered are related to the fact that the problem in question is distant from the place where they live:

> "*For my life, as such, I don't think that [it's important], because I'm very far from the problem, so. . . I wouldn't be affected by whether or not the airport is constructed. But I believe that for the people who live there (. . .) it is a problem*" (E5) (problematic—construction of the airport).

> "*Sincerely, I don't think that [it's important] (. . .) Maybe because I am a bit far from where they are going to build the airport*" (E7) (problematic—construction of the airport).

That situation indicates the need for a better understanding of the interdependence between local and global problems, and the life of each one of us. At the same time, it is accepted that an approach which begins with a local problem, as recommended by UNESCO [6], facilitates the connection between individual people and the problem and its impact on a global scale, as well as the adoption of measures for change, not only in themselves, but also within society. Rios et al. [37] conducted a study with children between the ages of five and eight, and also found that both the action and the awareness of the children of environmental issues appear to be related to effective opportunities to exercise their environmental citizenship. Involvement with the local community prepares children to be critical about issues which affect the environment around them. Some children from the schools involved in the study said that they had already created projects on questions that they considered to be important for their community. For the authors, by having the possibility of participating in a meaningful project through which they seek to resolve local problems, the children are seen as agents with the capacity for acting in the community.

In another study conducted by Rios et al. [38], with 10-year-old children from a primary school situated in a forest, the authors concluded that it was important for them to be actively involved in the environmental issues of their community. This importance derives from what they had learned, and from the exercise of citizenship and activism they had experienced. Their practice consisted of actions conducted in the forest, partnerships in the community for resolving the problems identified and the organisation of a demonstration in the community. The authors argue that the real experiences that schools can provide for children's participation should be reinforced, considering their potentialities for learning and also for the contribution they can make to the sustainability of the earth.

Other potentiality from the EEC pedagogical approach mentioned by the pre-service teachers is connected with the promotion of intergenerational justice and equity. The participants value the development of competences related to respect for the environment and for the generations to come (n = 2). These data show that there is a concern about the future and the preservation of a healthy environment on this planet. Future generations have the right to the same living conditions as today.

> "*It's important for every one of us. If we're talking about the environment, this is about all of us. We live here. And those who have children want to leave a planet which continues to be habitable, and with a quality of life for the generations to come*" (E14) (problematic—exploration of lithium).

The educational potentialities attributed to the pedagogical approach by the participants appear to respond to the objectives of equity that were intended by the ODS and the OECD projects, such as Education 2030 [7]. Chawla and Cushing [39] also emphasise the importance of these processes which involve political action to help young people to seek the common good for a democratic citizenship.

3.2. Pre-Service Teachers' Evaluation of the Use of Web 2.0 Tools to Support the Implementation of the EEC Pedagogical Approach

The implementation of the EEC pedagogical approach was supported by the use of some Web 2.0 tools (e.g., a social media platform and a program for the design of mind maps).

In the planning actions stage, each group created a map of the controversy they were investigating, considering the inter-relations, values and actions defended by the interested

parties (stakeholders). For this task, the tool MindMeister was proposed (https://www.mindmeister.com/app/map/3015785696?t=5bjeVxHmld (accessed on 28 February 2022)).

The mapping of the controversy was identified as a difficulty by several pre-service teachers. However, the reasons presented for that evaluation were mainly connected with the gathering of relevant information about so many involved stakeholders, and not with the Web 2.0 tools used in this task. The identification of the interested parties in each environmental problematic and the existing inter-relations between them was the most difficult to undertake for several of the participants (n = 7). The survey of the main parties involved in the problem and the understanding of the interactions that could be established between them, understanding how they influence one another, proved to be an arduous task, as shown in the following excerpts:

> "*The most difficult thing to do was the actual controversy mapping. Because we had many people involved, and trying connect them to one another was the most difficult thing*" (E5) (problematic—construction of the airport).

> "*In addition, despite having been able to identify all of the stakeholders in advance, it was a little difficult to understand how they influenced one another*" (E9) (problematic—forests and fires).

This difficulty is also due to a lack of prior knowledge of this strategy and also the need for deep exploration of the subject and more attention from the teacher. Although they used two examples of mapping the controversy to help the groups to understand the idea, the approach was not sufficient to appropriate and clarify any questions in all of the work groups. In addition to the exploration and analysis previously applied to participants for another problematic, the presentation of controversy maps in class was a good opportunity to ask questions, fostering reflection on the relationships established. The explanation presented by each group made it possible to check what had not been understood, and it was possible for each group to make improvements to the mapping presented. The controversy maps showed that they considered various different stakeholders, and also showed how some stakeholders influenced others on the problem under analysis (Figures 1 and 2).

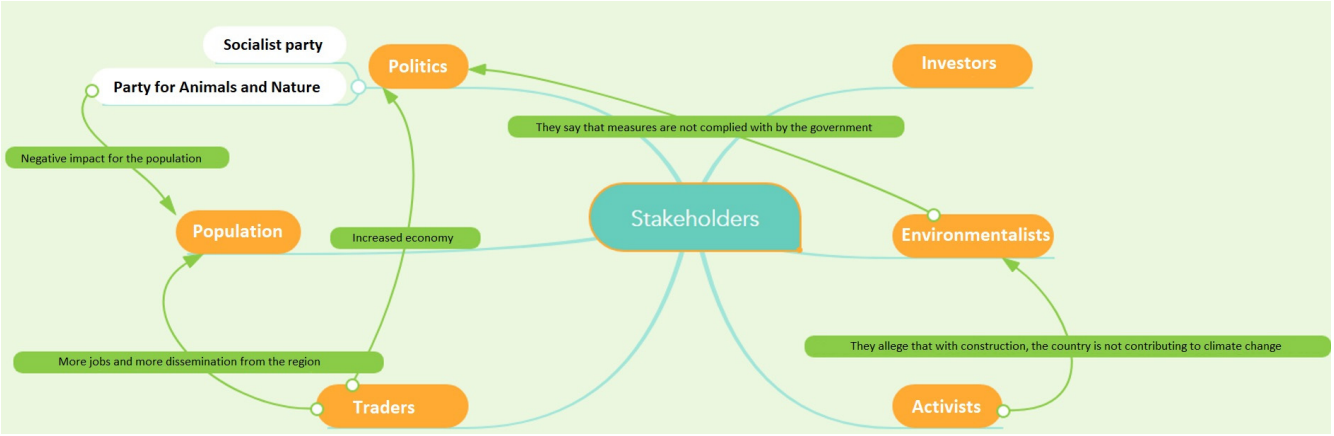

Figure 1. Controversy map created using MindMeister. Note: the original words in Portuguese were translated into English by the researchers.

In this task, some pre-service teachers (n = 4) mentioned difficulties exploring the tool MindMeister for building the map. Although some groups finally presented the controversy map using this tool (Figure 1), other groups—encountering some difficulties—opted to use alternative resources such as the Microsoft PowerPoint and Word programmes (Figure 2). In spite of some difficulties using specific tools for the task, several participants (n = 5) confirmed the usefulness of those tools for the controversies' cartography and the educational potentialities of this methodology—highlighted by Venturini [31,32] and Herve [34]—in

the appropriation of the controversies under study and in the characterisation of their complexity, organising and representing the interaction of the social actors involved.

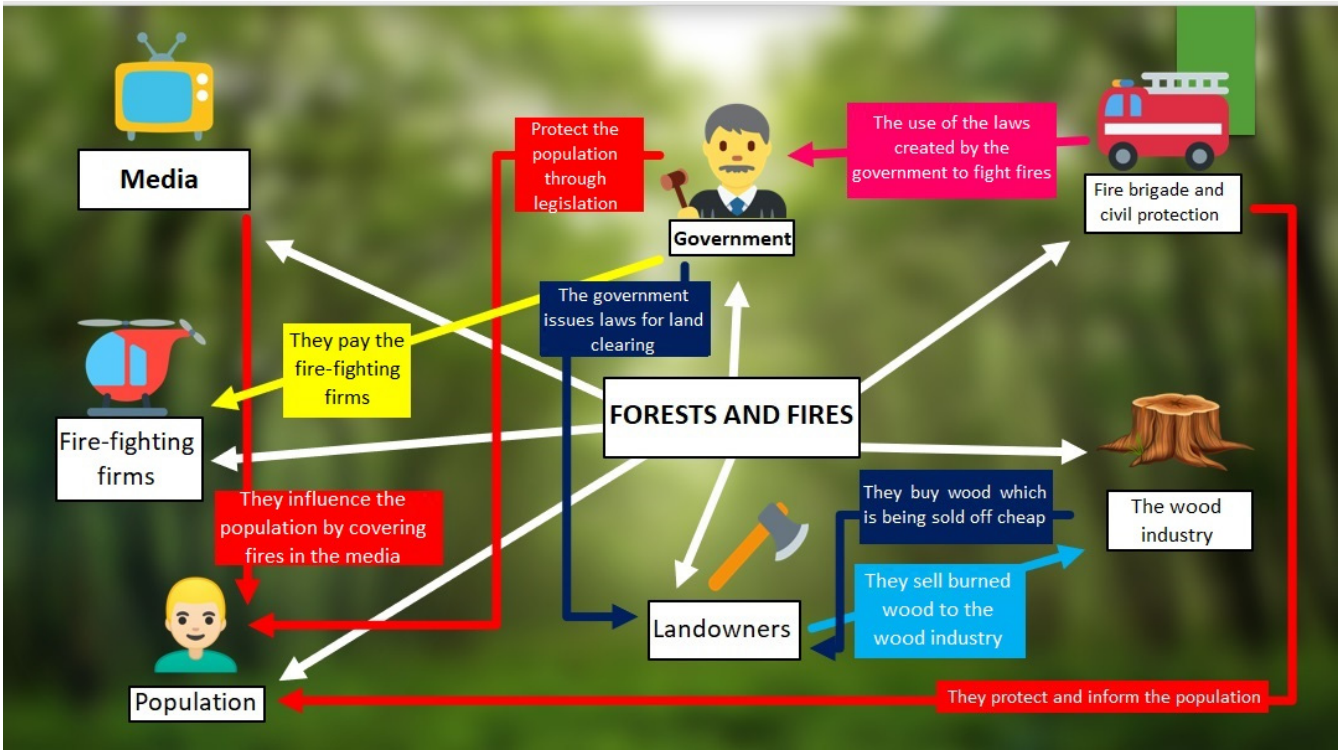

Figure 2. Controversy map created using PowerPoint. Note: the original words in Portuguese were translated into English by the researchers.

For the stages of "Networking & sharing in scales" and of "Environmental action & social change" the pre-service teachers created pages on Facebook on the different controversies investigated. The choice of Facebook, rather than any other social media platform available, was decided by the pre-service teachers and motivated by their previous personal experience with this platform. Through the promotion of those Facebook pages, they tried to influence and encourage the community to understand the importance of the problem under analysis and to modify their behaviour, with the internauts benefiting from more opportunities to extend their knowledge and share ideas.

Some pre-service teachers (n = 4) considered the creation of a Facebook page to be positive because it made it possible to raise people's awareness and involve them more.

> "*It was decided to create a Facebook page, which makes it easier for us to reach people*" (E6) (problematic—construction of the airport).

> "*I also found the Facebook page interesting because it was also a way to connect to the community*" (E8) (problematic—construction of the airport).

Many of those interviewed emphasised the possibility of participating actively in the community using a social network. Through Facebook, it is possible to inform and foster reflection among followers, through the sharing, discussion and understanding of the problem, and this can bring about a new way for people to see this. It is, therefore, a form of intervention in the community that can be far-reaching.

> "*With our Facebook page, perhaps we were able to reach more people and make them reflect a little, I think that is also a way. If they start to think through what we write on our Facebook page, if something starts to awaken in the mind of people, it's a step forward*" (E12) (problematic—food wastage).

> *"With social networks, it's increasingly easier to attract people's attention that way. And I'm speaking on the basis of the feedback we received. Not only from people who already knew about the problem, but also from people who didn't: We received many messages. As a group we tried to alert people to the problematic (. . .)"* (E5) (problematic—construction of the airport).

Like in the studies conducted by Zoras and Bencze [14], Zhang and Skoric [16], García Bermúdez et al. [17] and Andersson and Öhman [18], with students of basic and secondary school science, these participants recognised the advantage of using the Facebook social network, because it made it possible to give information and mobilise and encourage other people to join together for a cause, establishing different connections, which made it possible to reach new audiences.

In spite of these positive evaluations, some pre-service teachers pointed out difficulties with the use of the Facebook social network. In the opinion of some of the participants, raising awareness about the problem under study and interacting through Facebook was not easy because they did not know what would happen with the followers and friends of the page.

Despite the fact that various people had joined the page created by each work group, the most difficult thing was the involvement and participation of the followers of the page through comments. The great challenge was to foster interaction through this Web 2.0 tool (n = 3), and it was the reason for the reflection and sharing of ideas about the environmental problem under analysis.

> *"The difficulty I felt was with the interaction on Facebook. Create a Facebook page, or gain a response? It wasn't a problem with promotion, but more about getting an idea of the other party"* (E15) (problematic—exploration of lithium).

> *"For the dissemination on Facebook, the difficult thing was to get a response from the people who joined the page"* (E13) (problematic—food wastage).

Despite this difficulty, various suggestions were made to make their page a "friend" of groups and friends, including tips about titles and publications that could attract interest and curiosity and, consequently, the wish to create a publication about the subject. The actual course teacher defined a rule which consisted of each work group commenting on the page of another group in a reflexive way and with content, and they would have to reply to the comment left on their page (Figure 3).

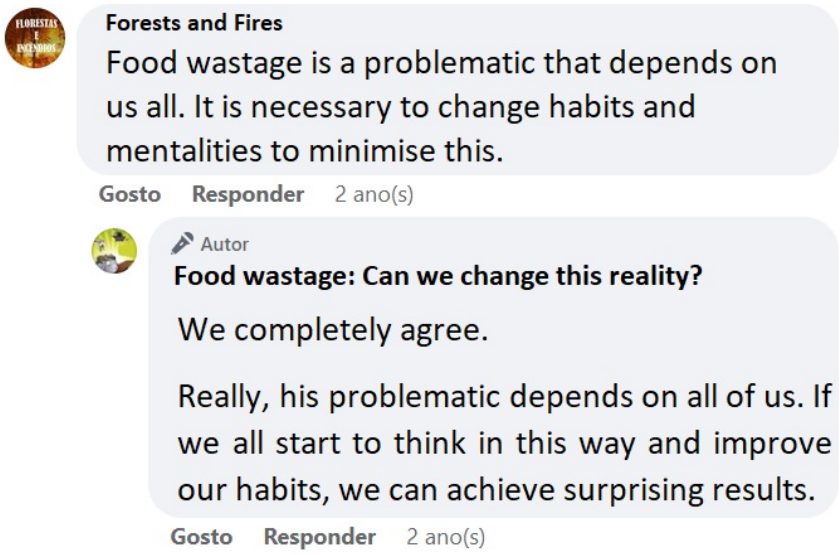

Figure 3. Example of a publication between two work groups. Note: the original words in Portuguese were translated into English by the researchers.

To enrich the reflection of each group even more, the teacher published a comment about each environmental problematic, which the group had to respond to on the basis of the sources consulted, showing their knowledge and understanding of the problematic in question (Figure 4).

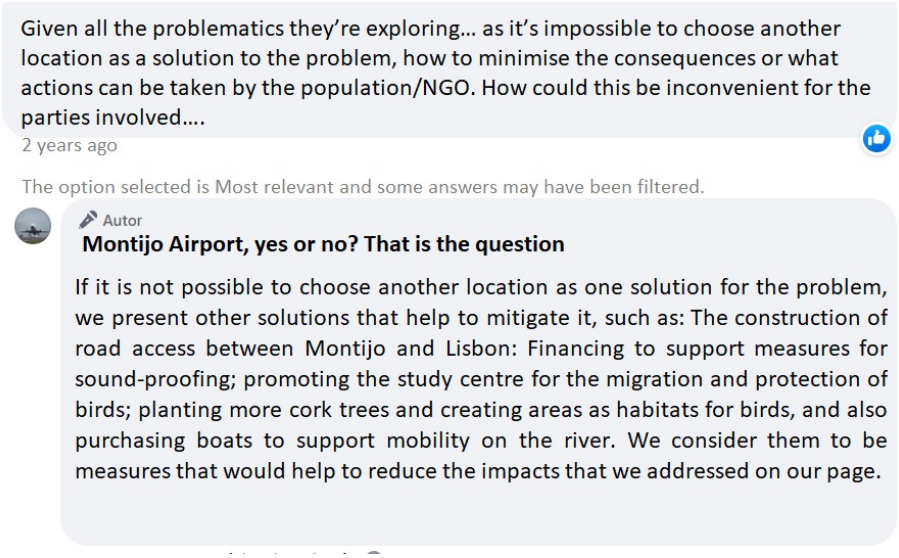

Figure 4. Example of a publication by the work group, together with the teacher. Note: the original words in Portuguese were translated into English by the researchers.

Another difficulty associated with Facebook and identified in the study of Zoras and Bencze [14] is to guarantee that the user and followers of the social network effectively read and appropriate the information published by the users and followers of the social network. The fact that it receives "likes" and is shared does not necessarily mean that the information is being read and, consequently, it might not be possible to achieve the desired objective, which is to produce real change in the followers.

The promotion of the Facebook page and the adaptation of communication to the target audience to which the published information was directed were also difficulties mentioned by the participants (n = 2). It is an activity which continued through time and therefore needed to be accompanied by weekly publications, which would appear to have made it difficult to decide what content to publish each week, with there also being an obvious lack of organisation between the members of the group about deciding what should be published and who should publish it.

> "*And also, with the page. There were times when we didn't know what to put there. (. . .) But sometimes I had an idea and when I got there, the colleague had already posted*" (E3) (problematic—save the bees).

> "*Communicating with the target audience, according to what we wanted, was not easy some days. We had to think about what to do, what audience I would have tomorrow, to continue the work in a consistent, meaningful way*" (E5) (problematic—construction of the airport).

After the end of the course, some pre-service teachers presented a suggestion related with the use of Facebook. They think that young people currently use other types of social network such as Instagram or Twitter and consider that these networks would have brought more responses from young people had they been used (n = 3).

> "*I think very few young people have Facebook and, when they do, it's because of school (. . .) Instagram, Twitter. I didn't go into my Facebook for years and I went back because the University groups went there. It's something that isn't very present anymore*" (E1) (problematic—save the bees).

This suggestion can be highly pertinent, especially when considering research results indicating that young people nowadays prefer other social media platforms over Facebook: the significance of Facebook in young people's social life is decreasing, substituted by platforms like YouTube, Instagram, WhatsApp and Snapchat [40,41].

3.3. Pre-Service Teachers' Evaluation of the Use of Distant Learning Context for the Implementation of the EEC Pedagogical Approach

The project took place in a distant learning context due to the COVID-19 pandemic; the groups had to work using formats that allowed them to interact and work on the different tasks as a group, such as videocalls on the Zoom platform, for example. According to some of the interviewees (n = 1), this was difficult for their group, because the interactions and dynamics created in the non-presential modality contributed very little to the co-operative work and creativity that characterised the presential work the most:

> "*(. . .) parts of the work were done at a distance from one another, and made it a bit difficult. Even with these Zoom sessions, we still lost some co-operation and creativity, as such, because we couldn't be there together in person and say "ah now I've found this or that" and a lot of time was wasted on these things*" (E14) (problematic—exploration of lithium).

However, a higher number of participants appreciated the possibility of working collaboratively with their group peers during the isolation imposed by the COVID-19 pandemic (n = 7). These results are similar with those from another educational intervention, conducted online in conditions of social isolation, designed to foster environmental citizenship among undergraduate students at a technological university. Online learning in this context also did not allow for an optimal implementation of the various instructional methodologies on which the intervention course was based, but peer teamwork was the most appreciated pedagogy from all that were implemented in that course [42]. Globally, the distance-learning context imposed by the pandemic triggered both positive and negative reactions.

4. Conclusions

This study is the first to test the education for environmental citizenship pedagogical approach with pre-service teachers in the context of a future teacher training initiative specifically designed for this purpose, and to assess the use of Web 2.0 tools to support the implementation of this approach. So, this study provides important information about what the EEC pedagogical approach can contribute towards for future teachers and teacher training.

The different stages in which the approach is organised are valued by the future teachers, because they permit a gradual development of their knowledge about the environmental problems addressed. The varied resources and strategies included in this approach also help to attract the interest and involvement of the students, challenging them to want to know, and to act more in more effective ways.

In general, considering the opinions of the participants, it is possible to say that the EEC pedagogical approach can contribute to the development, in pre-service teachers, of several attributes that are considered important for an environmental citizen, such as knowledge about the complexities of environmental problems and critical thinking, decision making, problem solving and communication skills for the resolution of those problems. These results support the allegations of Hadjichambis and Paraskeva-Hadjichambi [3] regarding the potentialities of the EEC pedagogical approach.

In addition to the development of these competences, the experience with the pedagogical model also fostered the didactic knowledge of the pre-service teachers, regarding how to plan and organise activities of this nature and adapt them to a group and a level of education—a knowledge that the study participants foresee using in their future teaching. The development of this pedagogical knowledge, along with the positive feedback from

pre-service teachers regarding the approach, can serve as strong indicators of the likelihood of them incorporating this approach into their future professional practice.

The Web 2.0 tools used in this course to support the implementation of the Environmental Citizenship Education pedagogical approach—Facebook and MindMeister—were positively appreciated by the pre-service teachers. In spite of some difficulties using the specific tools for the task, several participants confirmed the usefulness of those tools for the controversies' cartography and the educational potentialities of this methodology in the appropriation of the controversies under study, as well as in the characterisation of their complexity, organising and representing the interaction of the social actors involved.

The use of Facebook—the social media platform chosen by the pre-service teachers—was considered adequate for the stages of networking and environmental action, making it possible to reach new audiences, mobilising them to join together for a cause, influencing and encouraging the internauts to understand the importance of the environmental problems under analysis and to modify their behaviour—all important aspects of the EEC pedagogical approach. However, some difficulties were identified by the participants in stimulating the involvement and participation of the followers of the page: an activity that requires specific competences. According to the pre-service teachers, these difficulties can be justified with the fact that, nowadays, young people prefer other platforms like YouTube, Instagram, WhatsApp and Snapchat over Facebook. So, a future initiative involving the EEC pedagogical approach must integrate the platform that is favoured by young people in that specific moment.

The distance-learning context imposed by the COVID-19 pandemic, in which the course took place, did not function as a big barrier to the implementation of the EEC pedagogical approach. Interestingly, the online context was perceived by some pre-service teachers as a disturbing factor for collaborative work, while others appreciated the possibility of working collaboratively with their group peers during the isolation period imposed by the pandemic.

Future research should build on the limitations of this study. First, it would be important to repeat this study under an educational context that is not grounded solely on distance learning and with a larger and more gender-diversified cohort of students. A larger student cohort, complemented with a pre–post application of the Sustainability Consciousness Questionnaire—which already showed potentialities in measuring the impact of educational interventions structured according to the EEC pedagogical approach [22]—could allow for the identification of the course influence on specific cognitive, affective and behavioural variables that comprise environmental citizenship. Secondly, in order to better evaluate the impact of the course on the teachers' environmental citizenship competences and classroom practices, it would be interesting to implement a longitudinal research study focused on their trajectories, evaluating how teachers' perceptions on environmental citizenship education evolve from their pre-service training into their teaching practices within school classrooms.

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References

1. Schild, R. Environmental citizenship: What can political theory contribute to environmental education practice? *J. Environ. Educ.* **2016**, *47*, 19–34. [CrossRef]
2. Dobson, A. Environmental Citizenship: Towards Sustainable Development. *Sustain. Dev.* **2007**, *15*, 276–285. [CrossRef]
3. Hadjichambis, A.C.; Paraskeva-Hadjichambi, D. Education for Environmental Citizenship: The Pedagogical Approach. In *Conceptualizing Environmental Citizenship for 21st Century Education*; Hadjichambis, A.C., Reis, P., Paraskeva-Hadjichambi, D., Činčera, J., Pauw, J.B., Gericke, N., Knippels, M.C., Eds.; Springer: Cham, Switzerland, 2020; Volume 4, pp. 237–261.
4. UNESCO. *Education for a Sustainable Development Goals. Learning Objectives*; UNESCO: Paris, France, 2017.
5. Georgiou, Y.; Hadjichambis, A.C.; Hadjichambi, D. Teachers' Perceptions on Environmental Citizenship: A Systematic Review of the Literature. *Sustainability* **2021**, *13*, 2622. [CrossRef]
6. UNESCO. *Education for Sustainable Development: A Roadmap. Education 2030*; UNESCO: Paris, France, 2020.
7. OECD. *The Future of Education and Skills. Education 2030. The Future We Want*; OECD: Paris, France, 2018.
8. Hodson, D. Becoming Part of the Solution: Learning about Activism, Learning through Activism, Learning from Activism. In *Activist Science and Technology Education*; Bencze, J.L., Alsop, S., Eds.; Springer: New York, NY, USA, 2014; pp. 67–98.
9. Alsop, S.; Bencze, L. Activism! Toward a more radical science and technology education. In *Activist Science and Technology Education*; Bencze, J.L., Alsop, S., Eds.; Springer: New York, NY, USA, 2014; pp. 1–19.
10. Calabrese Barton, A.; Tan, E. It Changed Our Lives: Activism, Science, and Greening the Community. *Can. J. Sci. Math. Technol. Educ.* **2010**, *10*, 207–222. [CrossRef]
11. Davies, I.; Evans, M.; Fulop, M.; Kiwan, D.; Peterson, A.; Sim, B.-Y.J. *Taking Action for Change: Educating for Youth Civic Engagement and Activism*; University of York: York, UK, 2019.
12. Piassi, L.; Reis, G.; Maclure, R.; Gomes, E.; Santos, F.; Oliveira, T.; Pupo, S.; Teixeira, T.; Delgado, L.; Rodrigues, M.; et al. Science Stand: A Brazilian Activist Science & Technology Outreach Initiative. *J. Act. Sci. Technol. Educ.* **2019**, *10*, 1–10.
13. Santos, W.; Singh, D.; Cruz, L.; Piassi, P.; Reis, G. Vertical Gardens: Sustainability, Youth Participation, and the Promotion of Change in a Socio-Economically Vulnerable Community in Brazil. *Educ. Sci.* **2019**, *9*, 161. [CrossRef]
14. Zoras, B.; Bencze, L. Utilizing Social Media to Increase Student-Led Activism on STSE Issues. In *Activist Science and Technology Education*; Bencze, J.L., Alsop, S., Eds.; Springer: New York, NY, USA, 2014; pp. 435–449.
15. Scherman, A.; Valenzuela, S.; Rivera, S. Youth environmental activism in the age of social media: The case of Chile (2009–2019). *J. Youth Stud.* **2022**, *25*, 751–770. [CrossRef]
16. Zhang, N.; Skoric, M.M. Media use and environmental engagement: Examining differential gains from news media and social media. *Int. J. Commun.* **2018**, *12*, 380–403.
17. García Bermúdez, S.; Reis, P.; Vásquez Bernal, B. Facebook como herramienta para promover el activismo ambiental en las clases de ciencias [Facebook as a tool to promote environmental activism in science classes]. *Enseñanza Las Cienc.* **2022**, *40*, 1–20.
18. Andersson, E.; Öhman, J. Young people's conversations about environmental and sustainability issues in social media. *Environ. Educ. Res.* **2017**, *23*, 465–485.
19. Torres-Harding, S.; Baber, A.; Hilvers, J.; Hobbs, N.; Maly, M. Children as agents of social and community change: Enhancing youth empowerment through participation in a school-based social activism project. *Educ. Citizsh. Soc. Justice* **2018**, *13*, 3–18. [CrossRef]
20. Reis, P. Promoting students' collective socio-scientific activism: Teacher's perspectives. In *Activist Science and Technology Education*; Bencze, J.L., Alsop, S., Eds.; Springer: New York, NY, USA, 2014; pp. 547–574.
21. Krstovic, M. Preparing students for self-directed research-informed actions on socioscientific issues. In *Activist Science and Technology Education*; Bencze, J.L., Alsop, S., Eds.; Springer: New York, NY, USA, 2014; pp. 399–417.
22. Linhares, E.; Reis, P. Initiatives d´activisme en formation initiale de professeurs: Préparer à l´action et à la transformation [Activism initiatives in initial teacher education: Preparing for action and transformation]. *Rech. Didact. Sci. Technol.* **2020**, *21*, 193–209.
23. Ariza, M.; Boeve-de Pauw, J.; Olsson, D.; Van Petegem, P.; Parra, G.; Gericke, N. Promoting Environmental Citizenship in Education: The Potential of the Sustainability Consciousness Questionnaire to Measure Impact of Interventions. *Sustainability* **2021**, *13*, 11420. [CrossRef]
24. Hadjichambis, A.C.; Paraskeva-Hadjichambi, D.; Georgiou, Y. Evaluating a Novel Learning Intervention Grounded in the Education for Environmental Citizenship Pedagogical Approach: A Case Study from Cyprus. *Sustainability* **2022**, *14*, 1398. [CrossRef]
25. Goldman, D.; Ayalon, O.; Baum, D.; Haham, S. Major Matters: Relationship between Academic Major and University Students' Environmental Literacy and Citizenship as Reflected in Their Voting Decisions and Environmental Activism. *Int. J. Environ. Sci. Educ.* **2015**, *10*, 671–693.

26. Yavetz, B.; Goldman, D.; Pe'er, S. Environmental Literacy of Pre-service Teachers in Israel: A Comparison between Students at the Onset and End of Their Studies. *Environ. Educ. Res.* **2009**, *15*, 393–415. [CrossRef]
27. Yin, R.K. *Estudo de Caso: Planejamento e Métodos [Case Study: Planning and Methods]*, 2nd ed.; Bookman: Porto Alegre, Brazil, 2001.
28. Bogdan, R.; Biklen, S. *Investigação Qualitativa em Educação [Qualitative Research in Education]*; Porto Editora: Porto, Portugal, 2006.
29. Quivy, R.; Campenhoudt, L. *Manual de Investigação em Ciências Sociais [Handbook of Social Science Research]*; Gradiva: Lisboa, Portugal, 2005.
30. Bardin, L. *Análise de Conteúdo [Content Analysis]*, 5th ed.; Edições 70: Lisboa, Portugal, 2009.
31. Venturini, T. Building on faults: How to represent controversies with digital methods. *Public Underst. Sci.* **2012**, *21*, 796–812. [CrossRef]
32. Venturini, T.; Ricci, D.; Mauri, M.; Kimbell, L.; Meunier, A. Designing controversies and their publics. *Des. Issues* **2015**, *31*, 74–87. [CrossRef]
33. United Nations, Independent Group of Scientists appointed by the Secretary-General. *Global Sustainable Development Report 2019: The Future Is Now—Science for Achieving Sustainable Development*; United Nations: New York, NY, USA, 2019.
34. Herve, N. Cartographier des controverses pour apprendre la complexité des technosciences: L'étude des gaz de schiste en lycée agricole [Mapping controversies to learn about the complexity of technosciences: The study of shale gas in agricultural high schools.]. *Rev. Francoph. Du Dév. Durable* **2014**, *4*, 155–170.
35. Ariza, M.R.; Christodoulou, A.; van Harskamp, M.; Knippels, M.-C.P.J.; Kyza, E.A.; Levinson, R.; Agesilaou, A. Socio-Scientific Inquiry-Based Learning as a Means toward Environmental Citizenship. *Sustainability* **2021**, *13*, 11509. [CrossRef]
36. Linhares, E.; Reis, P. Práticas de Cidadania Ambiental na Formação Inicial de Professores de Educação Básica: Um Estudo de Caso [Environmental Citizenship Practices in the Initial Training of Basic Education Teachers: A Case Study]. *Rev. Interuniv. Form. Del Profr.* **2022**, *97*, 163–184.
37. Rios, C.; Neilson, A.L.; Menezes, I. Citizen Children Raising Their Voices and Striving to Save the Planet . . . and Themselves. In *International Perspectives on Educating for Democracy in Earl Oy Childhood*; DeZutter, S., Ed.; Routledge: New York, NY, USA, 2023.
38. Rios, C.; Neilson, A.L.; Menezes, I. "Vamos fazer-nos ouvir": Ativismo climático de crianças na floresta local ["Let's make ourselves heard": Children's climate activism in the local forest]. *Educ. Soc. Cult.* **2022**, *62*, 1–26.
39. Chawla, L.; Cushing, D.F. Education for strategic environmental behavior. *Environ. Educ. Res.* **2007**, *13*, 437–452.
40. Swart, J. Tactics of News Literacy: How Young People Access, Evaluate, and Engage with News on Social media. *New Media Soc.* **2023**, *25*, 505–521. [CrossRef]
41. Laor, T. My social network: Group differences in frequency of use, active use, and interactive use on Facebook, Instagram and Twitter. *Technol. Soc.* **2022**, *68*, 101922. [CrossRef]
42. Telešiene, A.; Boeve-de Pauw, J.; Goldman, D.; Hansmann, R. Evaluating an Educational Intervention Designed to Foster Environmental Citizenship among Undergraduate University Students. *Sustainability* **2021**, *13*, 8219. [CrossRef]