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Article

Children's Perception of Climate Change in North-eastern Portugal

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Abstract: Despite the impact that climate change is having on our planet and considering its consequences for future generations, much of the academic literature focuses on adolescent and adult perceptions, giving little relevance to children's perceptions. Children's voices have the potential to influence public opinion, which may in turn determine the direction of a new policy on the climate crisis. In this context, it is urgent that we understand how children perceive this problem. This quantitative study was based on the application of 245 questionnaires to children aged between 9 and 13 years old from five schools in north-eastern Portugal, more specifically in the region of Trás-os-Montes. To collect the data, we used a questionnaire with 26 questions, being 24 of closed response, Likert type, one of them open response, and one multiple choices. The data were statistically treated using SPSS software. The results show that most of the children express concern about the study's potential problem. However, they show some doubts and a lack of knowledge about some of the themes. We found differences between the two study cycles, with children in the 6th grade having a higher average in the understanding of the phenomenon, as well as the level of education of the parents being positively correlated with a more ecocentric posture. The female students also showed a slightly more ecological posture, i.e., an eco-friendlier posture. From the results obtained, we can open new paths for future research and contribute to the definition of policies and educational practices since the school has the responsibility to cooperate in the production of values, attitudes, and pro-environmental behaviours.

Keywords: children; climate change; climate literacy; education; sustainable development

1. Introduction

There is a growing concern about how children understand climate change issues [1]. By having access to these studies on this subject, we can inform better educational opportunities and identify the best ways to address these challenges [2]. Education should contribute to mitigating the problem and reducing the vulnerability of people and communities faced with the consequences of climate change [3]. Allegedly, there seems to be a deficit in the ability of schools to sensitize about this issue [4], as reported in a project carried out by the School Education Gateway [5], which showed that teachers in countries such as Spain, Turkey, Romania, and Canada do not have adequate skills to educate students about the climate crisis. Other studies that focused on understanding children and adolescents' perceptions of the causes of climate change found that these tended to be unclear [6],[7],[8]. In other authors, they found several gaps in knowledge and that they undervalue the role of individual actions, showing that they feel impotent in relation to the issue in question [9][10]. Some authors also point out that children in these age groups often associate the ozone layer with climate change, as well as show difficulty in enumerating causes, consequences, and solutions [1], [11],[12]. Children mostly depend on the information given to them by adults in various contexts, including at school. Therefore, they acquire confusions, misconceptions which reflect the misinformation they

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may be receiving [13]. In some of the textbooks, the mechanisms of climate change are often poorly explained or are unclear in the way they present the information. This leads to doubts that reportedly seem to persist throughout adolescence into adulthood [14]. Addressing climate crisis-related content directly in pre-school education could be an effective way to help break the cycle of gaps in adulthood. We consider that climate change education is an area that aims at designing and developing educational responses based on informed decisions that are effective in the context of the climate crisis. It follows that such decisions should be consistent with the goals of mitigation and adaptation to the inevitable consequences of a changing climate. We argue that climate change education should include a sense of urgency, emphasizing the long-term systemic, complex, and unpredictable effects on the biosphere. In this sense, the education system should strengthen climate literacy for all to enable society to mitigate this issue [15].

It is undeniable that the school is required to prepare children for the societal challenges in the context of an uncertain/unpredictable future, promoting the development of skills that allow them to question established knowledge, integrate emerging knowledge, communicate efficiently, and solve complex problems.

Although climate education has gained significant attention in Europe and the rest of the world, Italy remains the only European Union country that has made climate change education compulsory in schools. In 2020, almost half (47%) of the national curriculum frameworks of 100 countries analysed, including Portugal, made no reference to climate change. Of the few that addressed the topic, it was in a superficial and not very relevant way [16].

In this sense, teachers play a crucial role in empowering young people to develop their understanding and attitudes towards climate education. [5] In the case of Portugal, the subject of climate change is part of the national curriculum throughout compulsory education, i.e., from pre-school education to the end of secondary education, with this subject being addressed in the curricular areas of world knowledge, environmental studies, and citizenship, as shown in Table 1.

In our study sample, in basic education, environmental issues are transversal, and according to the document Essential Learning (EA), they are addressed in the curriculum and can be articulated between other areas (Table 1).

Table 1. Areas where Climate Change is discussed at school. [17],[18].

Nível de Ensino	Área Curricular
1º Cicle	- Citizenship and Development - Study of the Environment
2º Cicle	- Natural Sciences

We consider that it is imperative to know the perceptions that primary and secondary school students in the north-east of Portugal have about climate change; to understand if they focus on a more anthropocentric position, if they characterise nature as something instrumental, or if they prioritise the human action of control and domination over nature with the aim of exploiting its resources. Or if, on the other hand, they may take a more ecocentric stance, in which they defend nature, even if, to do so, they may give up their materialistic and consumerist life. [19]. We also set out to understand if their perceptions of climate change varied according to the following variables: age, gender, year of schooling, and parents' qualifications. The Northeast of Portugal, where our study was focused on, is a vulnerable zone, according to the Climate Risk Index (IRC). This is a region very connected to the agricultural sector, a sector of great relevance and essential for the structuring of the territory. As it is known, weather conditions drastically affect agricultural productivity, making this a sector of great importance in the region [20],[21]. This study also meets objective number 13, sustainable development, which refers to the

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mitigation of climate change issues, and objective number 4, which refers to quality education. This theme is also addressed in the reference of education for sustainable development and in the national strategy of education for citizenship [3].

2. Materials and Methods

The research problem we propose to develop, and which will guide our investigation focuses on the identification of perceptions about climate change and how these are faced by 4th (first cycle) and 6th (second cycle) grade students. As we mentioned before, the north-eastern region is a region likely to face some of the consequences of climate change. Therefore, we cover schools inserted in a microclimate of the cold Transmontano land, and others in the warm land. Of the five collaborating schools, two are inserted in the microclimate of warm land trans-montane, (Vila Flor and Carrazeda de Ansiães) with a milder climate, marked by the Douro River valley and the valleys of its tributaries. The others, Vinhais, Macedo de Cavaleiros, and Bragança, are further north, are part of the regions of higher altitude, which constitutes the Terra Fria Transmontana, where the landscape is dominated by the low slopes of the Transmontane plateau. in table number 2, we present the synthesis of our objectives and the questions we intend to answer.

Table 2. Research Questions and Research Objectives**.**

Research Questions	Objectives
1 - What perceptions of climate change do first, and second cycle students have?	1-Identify perceptions of the first and second cycle students' perceptions of climate change.
2 - Are these perceptions the same according to the variables - age, gender, year of schooling, parents' qualifications?	2 - To find out whether perceptions of climate change differ according to age, gender, year of schooling and parents' education.

The data collection instrument used was a questionnaire, which was previously approved by the Ethics Committee of the University of Trás-os-Montes and Alto Douro and the Directorate-General of Education of Portugal, (nº0811200001). It also had the consent of the students' parents and included an informed consent form stating that the students agreed to participate in the research, which was for academic purposes only. The questions in the instrument were written in an objective and simple way so that they would be easy for the children to understand. The questionnaire included 24 closed-ended items using a Likert scale with 5 response options (totally disagree, disagree, indifferent/don't know, agree, totally agree). It also contained one open-response question and a final multiple-choice question. We focused on questions that could assess: (i) scientific understanding of the climate change phenomenon, (ii) consequences of climate change, (iii) anthropocentric vs. ecocentric posture.

The questionnaire was applied during the months of March to May 2022 to 4th grade students, this being the last year referring to the 1st cycle and the 6th grade referring to the last year of the 2nd cycle, in 5 schools in northern Portugal, in the region of Trás-os-Montes,

Next, we will present the results that will allow us to characterize, briefly and empirically, the students who collaborated in the study, in a total of 242, as shown in Figure 1 below:

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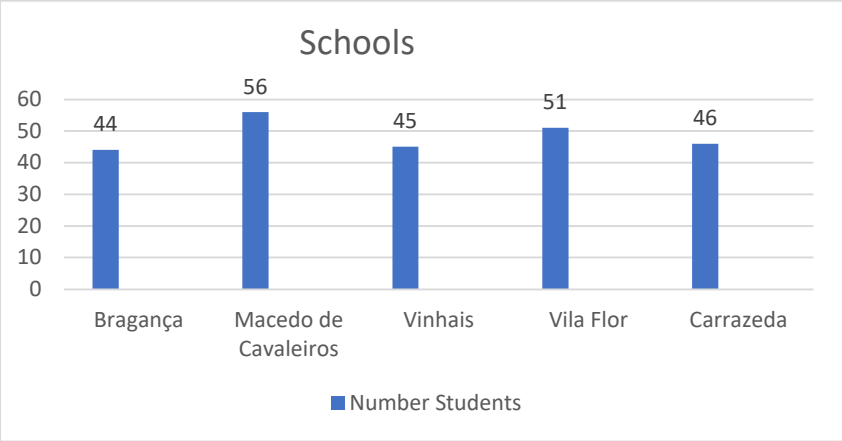

Figure 1. Number of students per school. N=242.

The school in which more students participated in the study was Macedo de Cavaleiros, with 56 pupils responding (n= 56), followed by Vila Flor (n= 51), Carrazeda de Ansiães (n= 46), Vinhais (n= 45) and finally Bragança (n= 44). The different number of responses is mainly since the size of the classes varies in the different school groups. Regarding the sample, the participating students are aged between 9 and 13 years, with an average age of 10 years, 113 in the 4th year and 129 in the 6th year. As far as gender distribution is concerned, 43% are female and 56% are male. The average time the students took to answer the questionnaire was between 14 and 24 minutes. It is worth mentioning that the application of the questionnaire was always carried out by the researcher in a classroom context, with the presence of the teachers, and suitable conditions were ensured so that the students did not feel awkward with the situation and, at the same time, could concentrate while completing it.

Data Analysis

Before applying the instrument, we conducted a pilot study with 12 students from another school, not included in this study, and two social sciences professionals, to test its reliability in academic terms. Regarding data treatment, we carried out a descriptive and inferential statistical analysis, we prepared a database, using the statistical software IBM SPSS v27.0 (SPSS, IBM Corporation, New York, NY, USA), which allowed us to carry out some statistical tests, selected according to the nature of the variables. For the descriptive analysis, several parameters were used for the distribution of variables, namely frequency, percentage, mean, and standard deviation. We rejected the Null Hypothesis (H0) and assumed that the sample does not follow a normal distribution for the inferential analysis, taking into account the fulfilment of the necessary criteria for parametric tests and after performing the Kolmogorov Smirnov Normality test, whose Null Hypothesis (H0) is that data are normally distributed, and given that the p-value was $p< 0.05$ for the variables under study. In this regard, non-parametric tests were used. To compare the degree of agreement with the climate change statements as a function of gender and year of schooling of the student, the Mann-Whitney test was applied, which is a non-parametric test suitable to compare the distribution functions of a variable at least ordinal, measured in two independent samples. To correlate the degree of agreement with the climate change statements, the student's age and the parents' education, Spearman's correlation coefficient was used, which is a non-parametric measure of association between two at least ordinal variables. This coefficient is obtained by replacing the values of the observations by their respective orders. Association measures quantify the intensity and direction of the association between two variables.

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3. Results

3.1. Level of concern in the sample, about climate change.

In Table 3 we can see that most students, around 70%, expressed their concern about climate change, of which 41% are very concerned. Even so, about 30% said they were not concerned about the issue.

Table 3. Results on concern about climate change.

N=242		
	Frequencies	**Percentage**
Totally Disagree	101	41,7%
Disagree	74	30,6%
Not Relevant	26	10,7%
Agree	30	12,4%
Totally Agree	11	4,5%

Even though most of the respondents show some concern about climate change, we think that the number of those who are not concerned is considerable. Climate change is a climate crisis, an urgency, and all children should be sensitive to this problem. But this may be because children are not familiar with the phenomenon, as we will see later.

In relation to the frequency of the statements of "Posture, Anthropocentric *vs* Ecocentric" (Table 4) the respondents have a level of disagreement (2=Disagree) with the statement "Climate change, does not concern me".

Table 4. Frequency of the agreement of the statement "anthropocentric vs ecocentric" posture.

	N	**Average**	Dp	Min	Max	Percentis		
Climate change does not concern me	242	**2,07**	1,2	1	5	25	50	75
						1	2	3

(1=strongly disagree | 2=disagree|3=indifferent|4=agree|5=strongly agree)

Still regarding the understanding of the phenomenon, when it comes to mentioning a consequence of climate change, the frequency and percentage are presented in the following table (Table 5)

Table 5. Survey results of the consequences of climate change. N=242.

Consequences	**Frequencies**	**Percentage**
I don't know	81	33,5%
Extinction	30	12,4%
Pollution	25	10,3%
Sea Level	17	7%
Don't have Water	15	6,2%
Drought	13	5,4%
High Temperature	8	3,3%
Volcano Activity	7	2,9%
More Fires	6	2,5%

4.1. List consequences of climate change.

For this question asking students to list at least one consequence of climate change, we present the results in the word cloud, represented in figure 2 below:

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Figure 2. Word cloud on students' responses to the question " List one consequence of climate change" n=242n=242.

Through Figure 2, aided by the previous table number 5, we intend to know the students' understanding of the phenomenon, namely its consequences. We can see that 33.5% (n= 81) of the students of the sample cannot enumerate a consequence of climate change answering that they didn't know. To clarify this aspect; the extinction of flora and fauna, with a representation of around 12% (n= 30) is the second most mentioned consequence by the responding students, followed by pollution, represented by 10.3% (n= 25). Other causes, although in a lower percentage, were mentioned by the students, such as: rising sea levels, water shortages, droughts, among others.

4.2. Male vs female perception of climate change

Next, we discuss the degree of agreement with the statements on climate change, according to gender, we present the significance value (Table 6), and then we present the parameters of the results that proved to be statistically significant.

Table 6. Significance value of the comparison of the degree of agreement with statements on climate change according to gender.

	p
I would like to learn more about climate change	**0,014**

Variable: ***Gender*** *| (p=Test Mann-Whintey)*

Table 7. Significant results of the comparison of the degree of agreement with the climate change statements according to gender *(p= Test Mann-Witney).*

	Male			**Female**			*dif*	*p*
	N	average	Dp	N	average	Dp		
I would like to learn more about climate change	105	**3,59**	1,14	137	**3,93**	1,04	0,34	0,014

.

The average level of agreement was higher among females. It is worth remembering that, regarding the distribution of the sample by gender, 43% are female and 56% are male, and even though the number of female students was smaller, the female students replied

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in a higher percentage that they would like to learn more about the problem of climate change.

3.4. Perceptions of climate change 4th year of schooling vs 6th year of schooling.

We did a cross-tabulation to see if there were differences in relation to the year of schooling and the question: Climate change is caused by humans, but it is also a natural phenomenon

Table 8. Frequency table, grade 4 vs grade 6, regarding the question: Climate change is caused by humans, but it is also a natural phenomenon. N=242.

	4º grade			**6º grade**				
	N	average	Dp	N	average	Dp	*dif*	*p*
Climate Change is caused by humans, but it is also a natural phenomenon	113	**3,37**	1,1	129	**3,65**	1,12	0,28	0,049

In this question, where we intended a scientific understanding of the phenomenon, it was possible to verify that the average was higher in the 6th grade in the statement "Climate change is caused by humans, but it is also a natural phenomenon" (p= 0.049).

3.5. Perceptions on climate change according to the variable "Education of the parents"

Next, we tried to find out if the parents' education could influence the students' perceptions of the causes of climate change. Table 9 gives an overview of the students' answers, considering the variable parents' education and the question "Our way of life, e.g., travelling, buying, and consuming overloads ecosystems." (r= 0.207)

Table 9. The student's degree of agreement and the school-age of the parent with more education was correlated by Spearman's coefficient.

	Age (student)	Parents Education Level
Our way of life, e.g., travelling, buying, and consuming overloads ecosystems	0,110	,207

As we can see from table 9, the educational level of the guardian is positively correlated with the degree of agreement of the statement "Our way of life, such as travelling, buying, and consuming overloads ecosystems." Although the intensity of the variables is a weak correlation (r= 0.207*) it is significant.

3.6. Distribution of averages in relation to the question "where do you learn more about climate change?

In a final multiple-choice question, we wanted to find out where students considered learning more about climate change. The answers varied, indicating school, TV, the internet, radio, family, books, or other. The answers are represented in figure 3.

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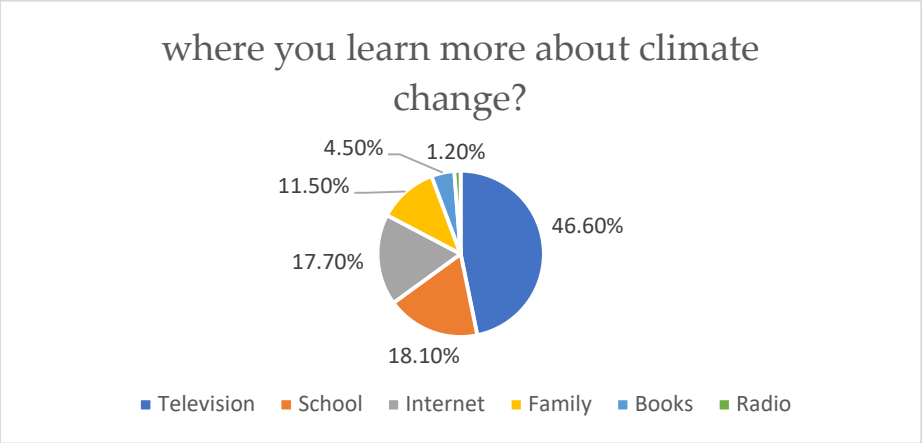

Figure 3. Distribution of average respondents' answers to the question "Where do you think you can learn more about climate change?".

By analyzing the graph, we can see that 46% of the students answered that it was on television, followed by 18% at school, 17% on the internet, 11.5% in the family, 4.5% in books and finally 1.24% on the radio.

4. Discussion

We think that we have met what other studies show, that there is indeed a gap regarding climate literacy in European and American schools [5], [6], [7]. It was possible to verify that 70% of the students are concerned about climate change. However, their knowledge of the phenomenon falls short. Regarding the understanding of the phenomenon, when analyzing table 3, we found that 33.5% could not list a consequence of climate change. Others mentioned pollution (10.3%) and volcanic activity (2.9%) because of climate change, when these should be mentioned as a cause, not a consequence. However, according to the literature, this type of response appears in other studies, in which respondents confuse natural geological phenomena with consequences of climate change by anthropogenic causes, demonstrating low levels of climate literacy [22], [15]. At a time when more should be known about climate change, there are many confusions, misconceptions, naïve theories, beliefs, and distorted perceptions, evidencing low levels of climate literacy. This fact concerns children, young people and adults and constitutes ideas that often become widespread due, in part, to the abundance of complex, divergent, inaccurate information or even errors that are propagated in an era of massified information [23]. As far as verifying whether the perception of climate change could vary according to the parents' academic qualifications is concerned, we found that the level of education of the parents is positively correlated with the degree of agreement with the statement regarding the perception of one of the causes of climate change. As for the gender variable, we found that female students showed greater sensitivity than male students. In fact, in another study, [24] it was found that women, more often than men, are more sensitive to climate change and are more willing to change their behaviour to reduce carbon dioxide emissions. However, there is no consensus in the available literature, as there are countries where women are more concerned than others, and there are others where men seem to be more concerned about environmental issues. Some of these differences may be attributable, for example, to differences in access to education [25]. It will therefore be a priority for all countries to provide climate change responsive education, as well as access to information on climate impacts for all population groups. In the variable year of schooling, 4th vs 6th grade, we found that the 6th grade has a higher average in understanding the phenomenon. This can be related to the fact that older students have an easier time understanding certain concepts on the subject, as well as the schooling, the incidence of the topic in their daily lives in the classroom, ends up enriching the way they understood the topic [26]. Another issue is related to the fact that most of the students stated that school

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is not the place to learn more about climate change. On the other hand, students pointed out that they also learned about climate change from TV (18.1%) and the Internet (17.7%). While we should praise the merit of some media in providing information, we should remember that such information is not always reliable or of good quality. They often use overly dramatic and catastrophic scenarios, sometimes even making "guesses" that are unlikely to happen and have little scientific basis, which can mislead the viewer [27],[28]. Scientific information about the global climate and its development is complex. Mass media, such as the Internet, are the main sources of information on climate change, although in some situations they can negatively affect levels of knowledge, problem awareness and behavioural intentions [29],[30]. Children and young people are growing up in a globalised digital world in which they process information from a wide range of varieties. They need to have critical literacy skills to navigate the potential "pitfalls" when consuming news, especially when using online sources and social media [30]. This being said, we argue that the education system should adapt and perhaps reinvent itself to enrich climate literacy and train more responsible and critical-minded citizens.

5. Study Limitations

This study has one limitation and the results should be interpreted taking into account that limitation. The main limitation is related to the sample that covered only one region of Northern Portugal.

6. Conclusions

This study proved that, although climate change concerns students and they want to know more about the subject, their perceptions are below the level of literacy that would be desirable, since this theme is highlighted as a priority and fundamental to solving this emergency. We therefore hope that this work will contribute to raising awareness among citizens, particularly children, and that they will adopt attitudes and behaviours in their daily practice, becoming more pro-environmental, so that they can exercise a more active, coherent, and responsible citizenship. We also believe that climate change should have more expression in curricula and educational resources, which may also include the initial and continuing training of educators and teachers. Climate literacy must go beyond the natural sciences and must be integrated into the various subject areas, from the social sciences (economics, sociology, anthropology, geography, etc.) to the humanities (philosophy, ethics, etc.) [26]. We believe that schools must play a key role in raising awareness and educating about climate change. As an institution responsible for the integral formation of citizens, the school, from early childhood education to higher education, must embrace climate education for greener progress and face this issue as a serious problem, considering it the great challenge of the twenty-first century.

7. Patents.

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Institutional Review Board Statement: The study received ethical approval from the Ethics Commission of University of Trás-os-Montes e Alto Douro, file number Ref. Doc102-CE-UTAD-2021, and date of approval: 30 March 2022.

The study was conducted in accordance with the General Direction of Portuguese Education, and approved with number 0811200001.

Informed Consent Statement: Informed consent was obtained from all subjects.

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

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