Chapter

Social Representation of Climate Change among Young Spanish University Students

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Abstract

Understanding the similarities and differences between what the population think and the available science on the causes, processes, consequences and solutions of anthropogenic alteration of climatic phenomena opens a window to demonstrate that the common culture surrounding Climate Change (CC) can have a greater influence than its scientific representation, since the weight of certain variables associated with the ways in which this common culture is constructed in societies generates differences in the degree of importance given to the phenomenon. Understanding the social representation of CC among university students is of great interest, since communication about it is usually restricted to the field of research and its threat potential has barely reached the general public, causing a discontinuous flow that does not connect significantly with climate science, resulting in different beliefs about climate change and a common culture around it that generates doubts and uncertainties.

Keywords: social representation, climate change, climate literacy, education, university

1. Introduction

We begin this chapter by taking the concept of cognition as a reference, as it is closely related to social representations as a useful study perspective for understanding how society appropriates the causes, consequences and solutions related to climate change. Cognition is the ability of living beings to process information and give it meaning, based on stimuli we receive from the environment through the senses. Thanks to this capacity, human beings assimilate and organise the information they receive in order to convert it into knowledge, through a series of mental processes such as perception, emotions, reasoning and language. These processes have a social dimension linked to communication, which makes it possible for us to interact with others to reach a consensus on ways of interpreting and explaining the world, its phenomena and events, and to articulate how to act accordingly.

These processes of interaction take on special relevance in a dynamic and changing world, constantly subject to social, environmental, economic and cultural transformations in which science and technology play an increasingly important role.

In order to internalise and interpret these changes, we rely unevenly on cultural constructions and scientific evidence that we incorporate into our cognitive baggage through frameworks of interpretation of facts, phenomena and events that give rise to shared representations in which the weight exerted by the influence of common culture is superimposed and often hinders an understanding of certain aspects of reality - for example, climate change - based on the appropriate appropriation of available scientific knowledge. Through processes of conceptual appropriation, linguistic meaning and cultural anchoring, we construct worldviews that translate into habits, behaviours, attitudes and lifestyles with which we confront the environmental problems of our surroundings on a daily basis, without realising that some of these cultural inertias are currently leading us to unprecedented environmental degradation that is causing, among other things, climate change. Clarifying the weight that these cultural constructions exert over scientific narratives in our way of understanding and explaining "objects" of a complex nature is an important challenge to promote changes that will allow us to reverse the impacts and alterations derived from anthropogenic climate change.

The research we present aims to understand to what extent the similarities and differences between what people think, from the individual to the collective, and the body of scientific knowledge available on climate phenomena and their anthropogenic alteration can be explained in relation to their causes, processes, consequences and solutions.

We justify the social relevance of this approach on the basis of the concept of a climate tipping point, i.e. the possibility of exceeding or having exceeded thresholds in climate change that can lead to abrupt or irreversible changes [1]. Several interconnected hotspots experiencing such changes have now been identified in the Amazon rainforest, the boreal forest, permafrost, Arctic sea ice and the Great Barrier Reef, among others [2].

The overshooting of these equilibrium limits is already causing millions of people to suffer the consequences of CC in the form of extreme poverty, migration, inequality, etc. Perhaps for this reason, shortly before COP25 in Spain, the European Parliament declared a climate emergency in the European Union, making it the first continent to do so.

Despite the alarming warnings provided by climate science and available scientific research, in general the governments of our countries have not incorporated anthropogenic CC as a priority issue in political agendas, so that communication of the emergency has been restricted to the spheres of scientific research and its threat potential has barely reached the general public. Nor has it been included as a priority in areas such as the economic, social, cultural or educational spheres, delaying the administrations from generating a flow of relevant information for society.

This flow has been discontinuous and, on many occasions, without meaningfully connecting society with climate science, resulting in different beliefs about climate change and a common culture around it that generates confusion, doubts and uncertainty.

And given that the social response to the threat posed by climate change depends more on how people and human collectives interpret and value it than on the representations that science constructs of it, it is therefore essential to understand how social representations of this phenomenon are being formed, as a basis for addressing the challenges involved in education and communication. Focusing this work on the study of representations of climate change in university students is justified because these are people who are at the most advanced levels of the educational system, which presupposes that they are people with a greater critical capacity to analyse the information they receive about CC and to discriminate its veracity and scientific rigour.

On the other hand, in a climate emergency scenario, universities must assume the responsibility of incorporating this situation into the training of their students in order to make them understand their responsibilities and their leadership role in the different disciplinary fields and social spheres in which they will have to work professionally.

Finally, this research is justified by the social diversity incorporated in the territorial and cultural contexts from which the samples of university students used are drawn. It is well known that the effects of climate change are cross-border and global, but they do not have the same impact in some areas of the planet as in others, so that the representation of the threat and the perception of risk may be different in each context.

In terms of the originality of the study, we can affirm that this research aims to explore other variants of what has already been studied so far in order to provide new data and broaden knowledge in this field.

On the basis that the study aims to deepen the understanding of the cognitive and socio-cultural processes involved in the representation of an "object" that is originally generated in the scientific field, the CC, this work aims to delve into the differences that may exist in the representation within the university community. More specifically, its novelty lies in checking how higher academic training can intervene and influence the social construction of SRs of CC, considering as a central hypothetical question the differences that may appear depending on the branch of knowledge, the degree and the academic year that students are studying and, therefore, their greater or lesser proximity to those scientific fields related to climate and its anthropic alteration.

On the other hand, we have innovated in the exploration of the territory/socio-cultural variable, making comparisons between university students who, being from different countries (i.e. Spain and Portugal), are considered at the same time within a common territory (which is the Iberian Peninsula) and yet experience different climatological characteristics on the north/south axis and belong to different socio-cultural and academic spheres.

Another novelty of this work is to use a measurement tool based on the best scientific literature on the causes, consequences, biophysical processes and solutions to climate change, relating it to some of the 17 Sustainable Development Goals proposed by the United Nations in Resolution 70/1 (2015), such as the SDGs associated with water and health.

Finally, another unique feature of this research is the multidisciplinary perspective it adopts. Climate change must be considered from an interdisciplinary perspective, as the causes that lead to it, the biophysical processes that shape it, its consequences and possible solutions are closely related, as it requires a complex approach that encompasses disciplines ranging from physics and biology to psychology and economics, among others. It is therefore essential to combine the contributions of the social and human sciences with those of the natural and technological sciences in order to tackle the climate crisis. In this way, and in the case in point, universities can be considered as tools for change, because education can change individual and social conceptions and enable the transformation of society. Furthermore, the perception of climate change is determined by many factors, but one of the most decisive in analysing it lies in education.

There is evidence based on research results that show that the common culture surrounding the phenomenon of climate change may have a greater influence than its scientific representation because the weight of certain variables associated with the ways in which this common culture is constructed in advanced societies generates differences in the degree of importance given to the phenomenon [3, 4]. Thus, we propose with this study to explore the social representation of climate change

in university students through different variables, which allow us to clarify some relevant aspects of these processes linked to the context of university education:

1. To analyse whether university training conditioned by the branch of knowledge and the academic course being undertaken influences the social representation of climate change.

2. To assess knowledge about the causes, consequences, biophysical processes and solutions to climate change in university students in order to assess how the common culture that has been created around climate change and the culture stemming from academic training influences the construction of this knowledge.

3. To find out whether university students know how to identify, through the causes, consequences, biophysical processes and solutions to climate change, the risks involved in this problem and, specifically, those related to extreme atmospheric phenomena and to health.

4. To determine whether the cultural and/or territorial/climatological contexts of university students' places of residence have a significant influence on the generation of their social representation of climate change.

2. Background

Climate change and global warming are two different concepts. Global warming refers to an increase in the average temperature of the Earth's surface due to an increase in the level of greenhouse gases and climate change refers to a long-term change in the Earth's or a region's climate that includes global warming and everything that affects the increase in greenhouse gases. According to the IPCC [5] it is a statistically significant variation in the mean state of the climate or in its variability, persisting over a period of time, which may be due to natural internal processes or to changes in external forcing such as volcanic eruptions or changes in land use, for example. And according to the United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, it is the change in climate attributed directly or indirectly to human activity that alters the composition of the atmosphere and that is in addition to natural climate variability observed over comparable time periods.

The IPCC published a report in 2018 detailing the most important aspects of understanding the 1.5-degree temperature increase; the associated impacts and risks; the current trajectory of emissions; and possible transitions consistent with the projected warming [6]. On the other hand, there are the SDGs; a Plan of Action for all countries, poor, rich and middle-income, to promote prosperity and protect the planet. The Sustainable Development Goals [7]. Specifically, goal 13 is the one that refers to climate action, and specifically, goal 13.3 which is the one that is most adapted to this research, is based on improving education, awareness and human capacity in climate change mitigation, adaptation, impact reduction and early warning.

The main theoretical basis of this research is Serge Moscovici's Theory of Social Representations, which states that a representation is an organised set of knowledge and one of the psychic activities thanks to which people make physical and social reality intelligible, integrate themselves into a group or into a daily relationship of exchanges and release the powers of their imagination by acting in their immediate environment [8].

Denise Jodelet adds that the field of representation designates the knowledge of common sense, whose contents make manifest the operation of certain generative and functional processes with a social character in a way that alludes to a form of social thought [9].

Robert Farr assumes that social representations appear when individuals debate topics of interest or when there is an echo of events selected as significant or of interest by those who control the media [10].

Another interesting contribution is that of Dan Speber [11], who recognises that representation is the relationship between what is represented, what is represented and the user of the representation. He adds a fourth element if the representation is produced by something other than the user, in this case, a scientific object that is difficult to understand, such as climate change.

Basically, representation makes the strange familiar and the invisible perceptible. They are cognitive systems of values, ideas and practices with the function of establishing an order that enables individuals to orient themselves in their material and social world and to master it, and to enable communication between members of a community [10].

In this way we come to speak of social representations of CC, and for an object to be studied from this theory, the following conditions must be met [12] it must constitute a specific object with an entity, it must have social relevance and it must be strictly collective knowledge, arising from the social interactions of a group.

Thus, in order for society to give meaning to CC, it must do so by knowing the information they receive about it. And the socio-cultural contexts in which this information is distributed and recoded must be taken into account. Furthermore, the profile of the audiences, the media and the methodologies used for its dissemination must also be considered, as well as the interferences inherent to any communicative process that hinder its understanding when it becomes "an object of common culture" [13].

Some lines of contemporary research with respect to the social representations of climate change are along the following lines:

> *Environmental hypermetropia, i.e. climate change is difficult to perceive, we see it as something distant, as most of the time we see it through the media. But when we perceive it, it is because we are conditioned by our beliefs, i.e. subjectively, common sense interprets reality based on new information that we have shared, even if it is not linked to the scientific representation to which it is related. Heras [13] quotes Markova [14] to emphasise that "objectification" can turn a complex scientific fact into something less differentiated, into something conventional and similar to what is already known. Once simplified, thinking will become less reflexive or non-reflexive. It will be framed within the symbolic social environment and circulated and recycled through the activities of the subjects [14].*

The study of cognitive limitations is another line of research, as CC is a difficult phenomenon to understand and we find it more difficult to comprehend complex and evolving systems such as climate, which is why we are not aware of the distant consequences of our actions [15].

Another line is the value placed on risk, i.e. if we think that an activity is positive, we will think that the risks derived from it will be lower and vice versa [16]. On the other hand, there are the responses to climate change, i.e. intuitive decision-making processes will be favourable if the decision-maker has sufficient information to evaluate the available options [13].

There is also the information deficit which means that, although environmental problems are identified in science, information from scientists also needs to be

incorporated into common sense so that they can be treated as real environmental problems [17].

And finally, there is the lack of public confidence in the scientific consensus and in the power that governments may have to put in place effective measures to mitigate the problem [18].

With this in mind, we now turn to some of the studies that have been carried out on the SRs of CC in university students. Some examples are those related to:

- Online courses or MOOCs on climate change [19].
- Project "The university in the face of climate change" [20].
- Social recognition of CC as a problem [21].
- Emotions towards climate change [22].
- Gender perspective focused on climate change [23].
- Geographical perception of CC [24].
- Confusions regarding biophysical processes of CC [25–27].
- Participation of university students in workshops or clubs related to CC [28].
- Procedural knowledge on biodiversity and climate change [29].

The study of social representations of climate change in groups of university students deserves special attention due to the fact that they are supposed to be educated people with sufficient capacity to consider, reason and, where appropriate, disagree with the information received in the media and, in some cases, in the degrees they are studying, and they are also attractive people to study the perception they have of this specific case since, from the results obtained, the future trend towards behaviour more or less involved in the intention to change behaviours that can reduce the phenomenon of climate change can be predicted. The role played by universities in this process deserves special attention as they are institutions of reference in the generation of scientific knowledge and in the training of both professionals and citizens who are sensitive to the threats of climate change and who are involved in the search for social, economic and technological alternatives.

The preamble of the 2015 Paris agreement recognises the importance of education, training and awareness-raising in access to information. But, in addition, article 12 of the agreement calls for cooperation in the adoption of measures to improve education, training, public awareness and participation and public access to information on climate change.

It is therefore hoped that, in the future, the inclusion of content on the climate crisis in school curricula will improve climate literacy, with climate literacy being understood as the understanding of the influence we have on the climate and vice versa. That is, a climate literate person will understand the essential principles of the Earth's climate system, know how to evaluate scientific information, be able to communicate this knowledge in a meaningful way, and be able to make informed decisions regarding actions that may affect the climate [30].

An international reference project in which this research is framed is the RESCLIMA Project which, in general terms, investigates how the social representation of climate change is internalised and expressed in different societies and

groups, such as university students, paying special attention to the processes of scientific transposition, interpretation and negotiation of meanings that shape this representation. The work carried out in this research is above all an attempt to explore the mechanisms by which certain lay theories about CC spread and become shared by different societies and groups without taking scientific knowledge into account.

To conclude, we cannot fail to mention the social movements and collectives that have emerged since the declaration of the climate emergency. These include Fridays for Future, Mothers for Climate, Teachers for Future and Extinction Rebelion.

These are movements made up mainly of students who are calling on governments to act immediately to avoid exceeding 1.5°C. They reproach them for their inaction. They reproach them for their inaction and the long negotiations without agreements. They reclaim the value of politics and the public and call for useful policy solutions through non-violent civil disobedience in an attempt to stop mass extinction, global warming and minimise the risk of social collapse. Due to these kinds of movements, other movements that already existed such as "NOMO" (No Mather) movements based on not having children for ecological reasons or people opting for more sustainable diets are now being reinforced. This may be determined by a characteristic of culture, which lies in the idea that culture transforms itself through the progressive generation of subcultures, which are attempts to register a change in the environment or a new differentiation of the social.

3. Method

This research is described as Empirical-analytical as it focuses on the analysis of the acquisition of climate knowledge through experience. We have used the quantitative method in quantifiable values such as means or percentages to explain or predict the correlation of variables. It is exploratory in scope because it examines a research problem about which there are doubts and it is considered descriptive because quantifiable information has been collected to be used in the statistical analysis of the selected sample. We could also mention that the research is of an evaluative nature because in this case it is a tool that could be used for the continuous improvement of the quality of educational programmes and the individuals included in them. It should be pointed out that the aim of this research is not to evaluate the teaching programmes of the degree programmes used for the analysis of the data, but rather to have an impact on society with the results obtained, so that if, through the students' degree of knowledge of CC, they can clarify a little better the deficiencies that these programmes have in the subject in question, they could be used as a reference so that programme evaluation professionals take them into account when including this phenomenon in these programmes. Finally, the theoretical approach is the Theory of Social Representations.

3.1 Sample

We have used a sample of undergraduate students from the public universities of Granada (Andalusia. Spain), having collected 522 questionnaires there, Santiago de Compostela (Galicia. Spain) with 644 and Miño (Braga. Portugal) with 560, for a total of 1709 students.

The reason why these three cities have been chosen is because they belong to the project where this research is framed, the RESCLIMA project, but another reason is because we wanted to take into account the variable of territory, which is considered of interest to compare the social representations that are generated in students

who, despite studying in universities located in the Iberian Peninsula, the weather conditions are different within the same seasons of the year.

We considered a probability sample by convenience and chose 16 different degrees: Biology, Environmental Sciences, Speech Therapy, Business Management and Administration, Civil Engineering, Translation and Interpreting, Statistics, Sociology, Law, Education, Economics, Forestry and Environmental Engineering, Agricultural and Food Engineering, Chemical Engineering, History and Geography.

For example, in a first analysis, only the part of the sample belonging to the University of Granada and all the branches of knowledge was used, or, for example, in another analysis, the part of the sample belonging to the University of Granada was used together with the part corresponding to the University of Santiago de Compostela and only including the variable of the "social sciences and humanities branch".

As for the instrument used to carry out this research, it is an ad hoc questionnaire, with 45 questions divided into two blocks.

The first block consists of 32 Likert-type questions that may or may not be related to climate change, so that the aim is to assess the student's climate literacy. The questions in this first block are divided into four different dimensions: causes, consequences, related biophysical processes and solutions to climate change. This first block covers all the dependent variables that have been used for the analyses that will be shown below.

The second block consists of the remaining 13 questions, where the questions are of a personal nature to find out to what extent the student feels responsible for climate change, whether he/she has participated in any specific activity on the subject in question or whether or not he/she believes that this phenomenon exists, for example. These questions are the ones we have used to carry out the last analysis as independent variables; however, in the rest of the analysis we have used the independent variables of degree, course, branch of knowledge and territorial context, which will be explained in more detail later on as to why they have been chosen.

The instrument used is a 2nd generation instrument with a reliability of 0.74 based on Cronbach's alpha coefficient. This reliability is not as high as would be

Analysis	Objetives	Sample	Dependent Variable	Independent Variable	Division of the questionnaire by dimensions	Statistics descriptive statistics of frequency	Post-Hoc test
1	1, 2, 3	University students from Granada of NST-SSH	1st block of questions	Degree Course Branch of knowledge	NO	% more answer chosen Media ($\bar{X}$)	Tukey
2	1, 2	University students of Granada and Santiago de Compostela de NST	1st block of questions	Degree Course	YES	% answer corrects and incorrects	NO
3	1, 2	University students of Granada and Santiago de Compostela NST-SSH	1st block of questions	Branch of knoweledge Course	YES	% answer corrects Media ($\bar{X}$) (of 32 to 128 points.) Standard deviation (σ)	Tukey
4	1, 2	University students of Granada and Santiago de Compostela SSH	1st block of questions	Degree	YES	% answer corrects Scores of 32 to 128 points. Media ($\bar{X}$) Standard deviation (σ)	NO
5	2, 3, 4	University stundents of Granada, Santiago de Compostela and Braga	15 questions concerning the water from the 1st block	7 questions of 2° block concerning to the perception of information/ training/ pro-environmental environmental	YES	% answers corrects of 1st block and % answers of 2nd answers block	Scheffé

Figure 1.
Specific methodology used for each of the analyses according to the objectives.

desirable, which is why it is currently being improved by means of a validation of the questionnaire by experts.

In the following image we can see the specific methodology used for each of the analyses according to the objectives we want to achieve (**Figure 1**).

3.2 Hyphotesis

Therefore, based on the above, 3 alternative hypotheses and a null hypothesis have been launched:

> *#H1: The knowledge and beliefs of university students in relation to the causes, consequences, biophysical processes and responses and/or solutions that have to do with climate change are influenced by the university education received. This knowledge will be more abundant and specialised in climate science when students come from natural science or engineering/technology backgrounds, and more so as they progress in their academic studies.*
>
> *#H2: Within climate change-related beliefs, climate change denial will be significantly associated with a representation that downplays the consequences of global warming, including health risks and other extreme weather events related to water, such that students from territorial contexts with high average rainfall and low average annual temperatures will tend to minimise the social representation of risks associated with climate change, and vice versa.*
>
> *#H3: The social representation of climate change around the causes, consequences, biophysical processes and responses and/or solutions of climate change and its link to water and health are created due to a significant relationship with the territorial and socio-cultural context, just as it is associated with the student's self-perceived information and pro-environmental attitude.*

Thus, if these hypotheses cannot be accepted, it is possible to think that the social representation of climate change in university students is not determined in a population group by the academic training received, the territorial and socio-cultural context so that, even if they are considered to belong to a scientifically literate environment, this is not significantly modifying the social representation of this phenomenon, at least in aspects that are related to the individual's cognition.

4. Results

We present the results through 5 different analyses:

4.1 Analysis 1

For the first analysis only students of the University of Granada from all branches of knowledge from first year to fourth year were surveyed. The results of this study are that 100% of the respondents recognise the existence of CC and its impact (global and individual) and that it is due to human causes and are highly confident about it. The students surveyed have very general knowledge about CC, but contradictions in climate science concepts. They give themselves medium individual and collective responsibility, however, the opinion regarding scientific consensus is 50%.

There are 3 questions in the questionnaire referring to health, 2 of which are answered incorrectly and only one correctly. It can be stated that the knowledge on CC causes/consequences/solutions is low and they add that the information received in the degree course/specific information on CC is also low.

Finally, significant differences were found between science and literature students, with the Environmental Science degree being the one with the highest knowledge of climate science and in questions referring to climate risks and health. Differences were also found between first-year and fourth-year students.

4.2 Analysis 2

The results of this analysis are the same as those of the previous analysis in terms of opinions on the existence of cc and the security in them, however, on this occasion we have compared it with a demoscopy of 2013 with the Spanish population in general and in terms of beliefs of the existence of cc increases by more than 8 percentage points and by 20 points in the security that it is happening.

In this second analysis, the questionnaire was divided into 4 dimensions. In the causes dimension it was observed that 83.5% believe that CC is mainly due to human causes. 77.3% think that there is scientific consensus on this, however, the percentage is divided between those who think that there is scientific consensus on the causes and those who do not.

On the other hand, 73.3% think that the greenhouse effect is of natural origin, which is correct, while 40.6% believe that the greenhouse effect is caused by human activity, which is not the case. We also found significant differences in the degree. We observe that in the dimension causes and origins of greenhouse gases (**Table 1**) practically all the questions are answered correctly, but in the dimension bio-physical processes (**Table 2**) we can observe that the percentage of correct questions is lower.

On the other hand, in the consequences dimension (**Table 3**), the percentage of correct answers is also quite high, as is the solutions dimension (**Table 4**), where all the questions are answered correctly.

4.3 Analysis 3

In this third analysis the questionnaire has also been divided by dimensions, but this time the sample includes university students from all branches of knowledge.

As can be seen in the following image, the average of the four dimensions is 2.77, with the answers dimension once again being the one that stands out from this average and once again it is the processes dimension that is below it (**Figure 2**).

	CORRECT	FALSE
Every time coal, oil or gas is used, we contribute to climate change (C)	96,0%	4,0%
Increased meat consumption contributes to climate change(C) (degree: χ^2 = 31,802; p <,05) / (course: χ^2 = 12,904; p <,05)	55,0%	45,0%
CO2 is the main gas responsible for climate change (C) (course: χ^2 = 10,20; p <,05)	81,9%	18,1%
CO2 is a natural component of the atmosphere (C)	95,3%	4,7%
Most of the greenhouse gases present in the atmosphere come from natural sources (C) (course: χ^2 = 10,185; p <,05)	31,9%	68,1%

Table 1.
Questions concerning the causes and origin of greenhouse gases.

	CORRECT	FALSE
The greenhouse effect occurs when gases retain part of the radiation reflected by the earth's surface (C)	93,1%	6,9%
If it were not for the greenhouse effect, life as we know it would not exist (C) (degree: χ^2 = 63,798; p <,05) / (course: χ^2 = 8,943; p <,05)	77,2%	22,8%
According to the Earth's climate history, there have been oscillations between colder and warmer periods (C)	96,8%	3,2%
Climate change is a consequence of the hole in the ozone layer (I) (degree: χ^2 = 35,049, p < .05)	55,2%	44,8%
Polar ozone hole causes melting of the poless (F)	87,2%	12,8%
CO2 causes ozone layer destruction (F) (degree: χ^2 = 22,220, p < .05)/ (course: χ^2 = 32,710, p < .05)	61,6%	38,4%
Acid rain is one of the causes of climate change (F)	61,2%	38,8%

Table 2.
Questions related to the bio-physical processes linked to CC.

	CORRECT	FALSE
All countries will suffer from climate change (C)	94,5%,	5,5%
A warmer planet will expand the area of incidence of tropical diseases (C)	89,8%	10,2%
Higher temperatures will favour the occurrence of extreme weather phenomena (cyclones, hurricanes, floods, etc.) (C)	96,1%	3,9%
Climate change will exacerbate desertification problems on the Iberian Peninsula (C)	93,8%	6,2%
(C)	95,5%	4,5%
Many islands and coastal areas will be submerged due to climate change (C) (degree: χ^2 = 23,701; p <,05) / (course: χ^2 = 13,995; p <,05	57,7%	42,3%
Climate change will decrease rainfall in my country (F)	64,2%	35,8%
The greenhouse effect puts life on Earth at risk (F) Climate change will increase the number of earthquakes and tsunamis (F)	63,8%	36,2%
Skin cancers will increase as a result of climate change (F)	83,2%	16,8%
Rising temperatures will affect all regions of the planet equally(F) (course: χ^2 = 15,512; p <,05)	77,9%	22,1%

Table 3.
Questions concerning the consequences of the CC.

	CORRECT	FALSE
If we stop emitting greenhouse gases we will be less vulnerable to climate change (C) (C)	80,2%	19,8%
Climate change would be reduced if we planted more trees (C)	75,7%	24,3%
Replacing private transport with public transport is one of the most effective ways of tackling climate change (C)	83,2%	16,8%
If we stop emitting greenhouse gases we will not be affected by climate change (F) (course: χ2 = 18.062; p <,05)	20,3%	79,7%

Table 4.
Questions concerning the solutions of the CC.

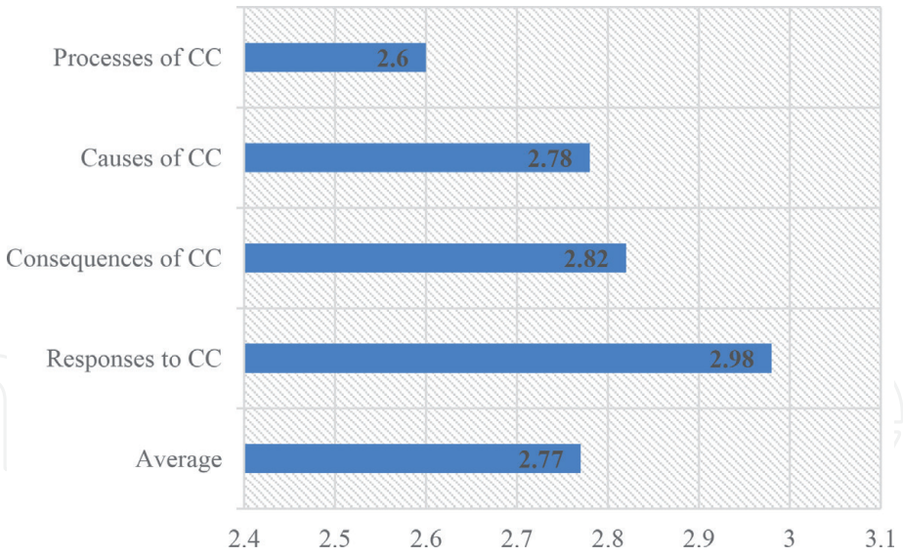

Figure 2.
Average score by dimension in the questionnaire.

	Academic Year				Academic Branch			
	Initial		Final		NST		SSH	
		SD		SD		SD		SD
Causes	2.76	0.31	**2.81**	0.33	**2.89**	0.33	2.70	0.29
Processes	2.57	0.38	2.65	0.41	2.71	0.40	2.53	0.38
Consequences	**2.79**	0.26	**2.86**	0.29	**2.89**	0.29	**2.77**	0.25
Responses	**2.99**	0.42	**2.98**	0.42	**3.02**	0.41	**2.96**	0.42
Total	2.75	0.22	**2.80**	0.25	**2.87**	0.24	2.71	0.21

Note: **bold** *text indicates above-average values, x = 2.77.*

Table 5.
Mean and SD by academic year and branch of knowledge.

If we compare this average by year and branch of knowledge (**Table 5**), once again, the answers dimension is the one that exceeds the average, but we can see that there are no differences as the year progresses and no major differences between those in science and those in the arts. When we look at the analysis of variance (**Table 6**) per item according to branch and year, we can see that there are no differences between science and arts, nor between first and last year in 28% of the questions in the questionnaire. On the other hand, there are no differences between science and arts, but there are differences in the year in 12% of the questionnaire, and on the other hand, there are differences in 43%. Finally, it is observed that there are differences in both the branch of knowledge and the academic year in 15% of the items.

So it can be concluded that:

Average number of correct answers to the total test is 65%, which means that the degree of climate literacy is medium.

There is a remarkable symmetry in the trends of the two independent variable handled: Course (64.78% at the beginning and 65.87% at the end) and Academic branch (68.1% for Natural Sciences and Technology (NST) and 61.68% for Social Science and Humanities (SSH).

The level of knowledge is not homogeneous.

A higher degree of Climate Literacy (CL) is observed in consequences of CC and responses to mitigate greenhouse gases (GHG) emissions or adapt to the

Statistical Significance	Items	No. items /total (and % of total)	Dimensions (n° items)
No differences by Branch or Year	2, 4,8, 10, 17, 21, 25, 28, 30	9/32 items (28.12%)	Causes (3)
			Consequences (5)
			Physical Processes (1)
Differences by Year but not by Branch	6, 22, 24, 32	4/32 items (12.5%)	Responses (2)
			Consequences (2)
Differences by Branch but not by Year	1, 2,7, 9, 12, 13, 15, 18, 19, 20, 23, 26, 29, 31	14/32 items (43.75%)	Responses (1)
			Causes (6)
			Consequences (2)
			Physical Processes (5)
Differences by Branch and Year	5, 11, 14, 16, 27	5/32 items (15,62%)	Responses (1)
			Causes (1)
			Consequences (1)
			Physical Processes (2)

Table 6.
Analysis of variance by item according to academic branch and year.

consequences of anthropogenic alteration of the Earth's climate; and a lower degree of CL in items referring to the causes and physical processes involved in CC.

Differences between NST vs. SSH are observed, reinforced when contrasting the results on the variable titration, with statistically significant differences in 60% of the items.

28% of the items show significant differences between 1st and last year and possible prevalence of common knowledge over scientific knowledge: there are items in which SSH students show a significantly higher competence than NST students.

4.4 Analysis 4

In this fourth analysis, the patterns are repeated in terms of questions referring to the existence of CC, in the certainty in it and that it is due to human causes. In this case, the social sciences and humanities students were used as the sample. The questionnaire was also divided into dimensions, but this time the results were shown as scores instead of averages. The maximum score that could be obtained was 128 and the minimum 32 (assigning 1 point to an incorrect answer and 4 to the correct one).

As can be seen in the figure (**Figure 3**), the average score is 86.71 points, and curiously, the degree with the highest score is History.

Once again, the consequences and solutions dimensions are the dimensions with the highest percentages of correct answers and therefore the highest levels of climate literacy.

Significant differences were also detected in all the categories analysed.

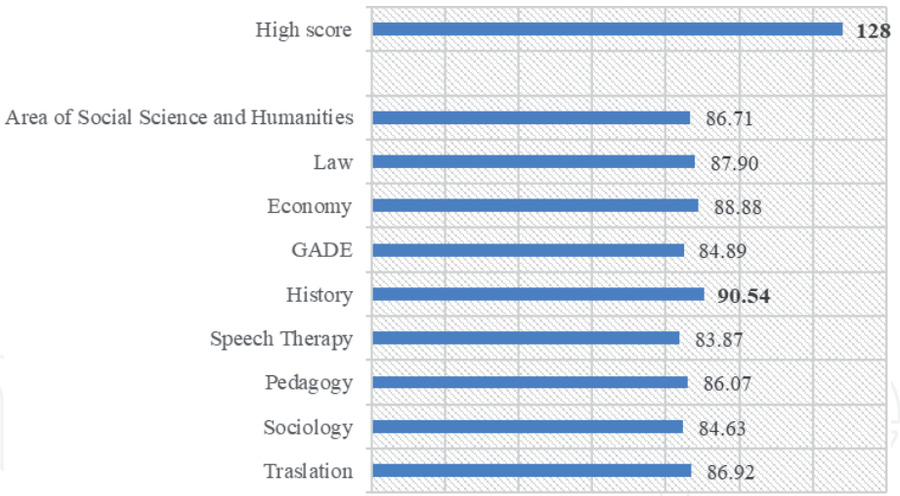

Figure 3.
Scores in the different analysed degrees.

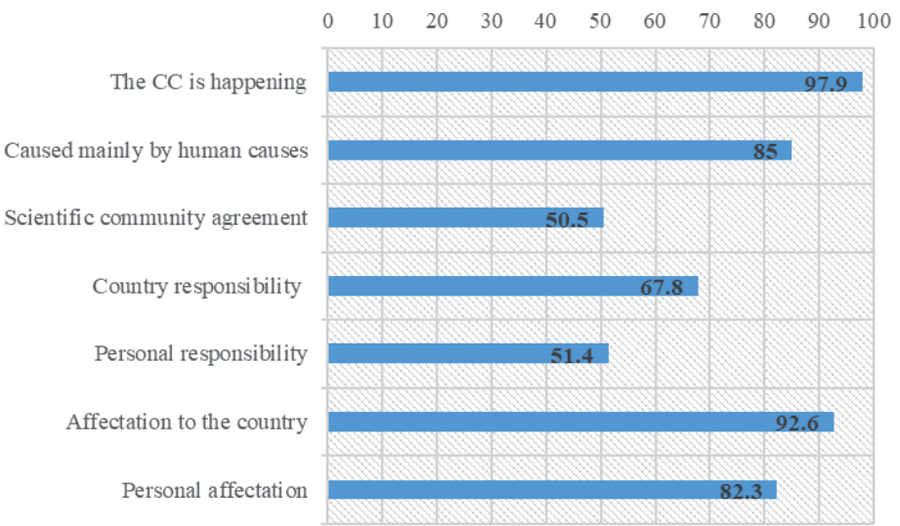

Figure 4.
General opinion questions on CC.

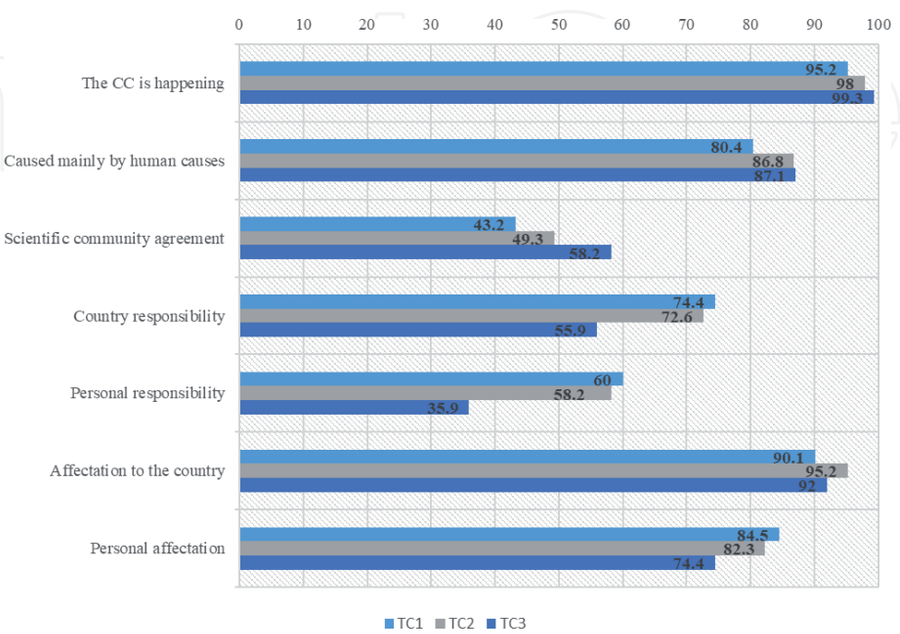

Figure 5.
General opinion questions on CC in the different context analysed.

4.5 Analysis 5

In this last analysis, branches of knowledge and academic year are ignored and importance is given to territorial context, self-perception of information and pro-environmental attitude. Based on this we make comparisons between these three different contexts which are students from Granada, Santiago de Compostela and Braga (in Portugal-which is considered the contrast context) through these variables according to those questions of the questionnaire that have to do with the water /CC relationship.

Figure 4 refers to the general opinion questions on CC, but analyses the results considering the three contexts together. As can be seen, the pattern of the existence of CC, caused by human causes, scientific consensus or responsibility, is repeated.

If we analyse these same questions, but now independently in each context (**Figure 5**), we can see that the results are practically the same, although in the

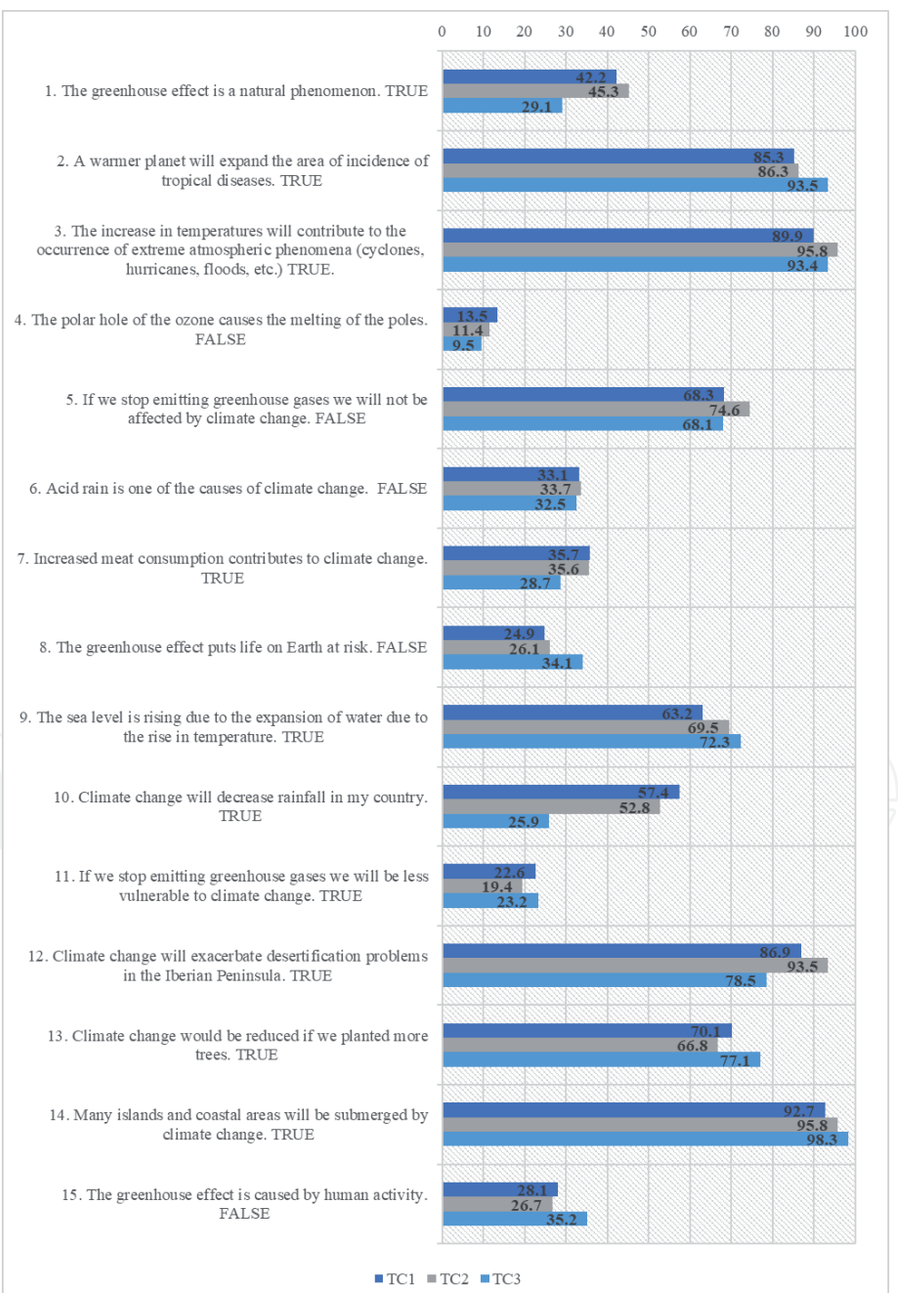

Figure 6.
Conceptual questions about CC.

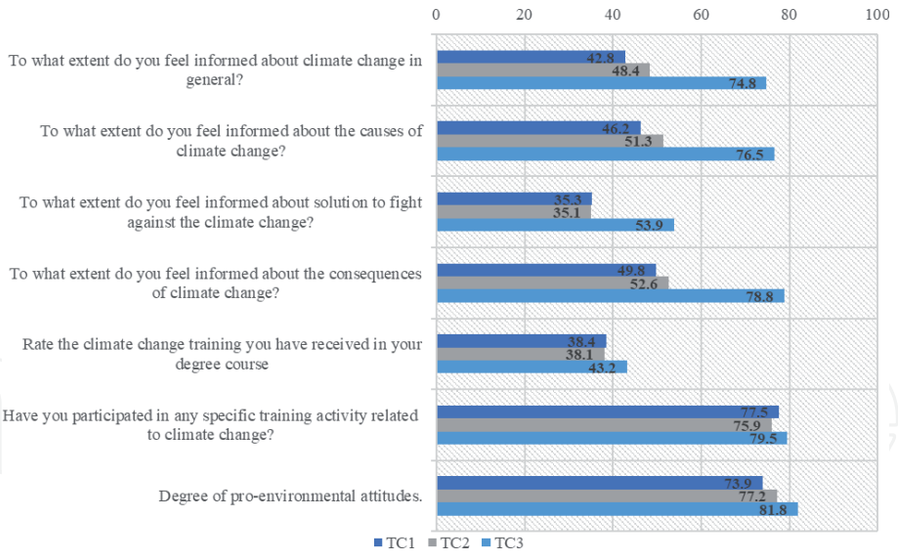

Figure 7.
Degree of information about CC and pro-environmental attitudes.

case of responsibility, it is the contrasting context that feels less responsible, both individually and collectively.

The next figure (**Figure 6**) shows the conceptual questions on CC, and as mentioned above, the questionnaire is now not divided by dimensions, but those questions that have to do with the relationship between water and CC have been chosen.

And although this is so, as can be seen, those questions that have not been answered correctly are also questions that, although related to water, also refer to biophysical processes that have to do with CC, so that we see again a reflection of the pattern of the previous results.

This is where the interpretation of the results of this analysis becomes more important. As can be seen (**Figure 7**) when questions are asked concerning the degree of self-perception about the information students have about the phenomenon, we see how the contrast context is the one that feels the most informed in all the questions asked, and the same happens when asked about the degree of pro-environmental attitude they have.

5. Discussion

This being so, the results are shown in terms of the three hypotheses that are put forward specifically for this analysis.

H1. Denying the existence of CC as a scientific phenomenon has a significant impact on the downward representation of the consequences of Global Warming and other extreme phenomena.

The results obtained are the same as those obtained previously and those consulted in other studies of the general population, which determines a denialism with a downward trend.

However, with regard to individual/collective responsibility, a greater "environmental hypermetropia" is denoted in territorial context 3.

H2. Territorial contexts with high average rainfall levels and low average annual temperatures exert a minimising influence on the social representation of the effects and perception of CC risk, whereas, on the contrary, territorial contexts with low average rainfall levels and high average annual temperatures will exert a maximising influence on the social representation of the effects and perception of CC risk.

In relation to the statements referring to CC effects and risk perception in cluded in the consequences dimension (increase in temperature, rainfall and desertification in the Iberian Peninsula), it can be seen that territorial context 3 is the one with the highest self-perceived information; however, it is the sample that obtains the lowest values of correct answers and incorrectly assesses the item "Climate change will reduce rainfall in my country". Accordingly, the second hypothesis is also rejected.

H3. Different political and cultural contexts between two territories generate different pro-environmental attitudes and feelings of information and therefore different social representations about the causes, consequences and solutions of climate change and its relation to water.

For this hypothesis, three results are concluded:

1. The self-perception of the level of information is higher in territorial context 3, followed by territorial context 2 and 1 in the following variables:

To what extent do you feel informed about climate change in general, on the causes of climate change and on the consequences of climate change.

2. The self-perception of the level of information is higher in territorial context 3 but the same in territorial context 1 and 2 on the variables: To what extent do you feel informed about climate change in general, on the causes of climate change and on the consequences of climate change?

To what extent do you feel informed about measures to combat climate change? How do you rate the training you have received on climate change/Rates your degree of pro-environmental attitude?

3. Participation in specific training activities on CC in all variables is the same for all three territorial contexts.

It should be noted that territorial context 3 (contrast sample) is the territory with the same rainfall and temperature characteristics as territorial context 2, and yet it does not comply with the first two premises, and therefore the third hypothesis is not supported either.

Thus, we conclude that:

The relationship of information sensation in different political-cultural contexts between two territories, generate self-perceptions of the level of information but not different social representations about causes, consequences and solutions to the climate crisis and its relationship with water.

Repeated confusions are perceived in the three territorial contexts in relation to the items referring to greenhouse gases, greenhouse effect, acid rain, ozone layer, meat consumption. Thus, it can be concluded that the pattern is repeated.

6. Conclussion

Almost all the university students surveyed are aware of the phenomenon of climate change. Recognise what is happening and that the changes are mainly due to human causes. The level of climate literacy of the university students is medium-high.

All the academics involved in this research, regardless of where they come from, agree that the impacts of climate change will happen both globally and regionally (in their country). They identify that there will be episodes of extreme

atmospheric. Phenomena and impacts on health, they are sure that the country where they live is more responsible for the causes of climate change than they are personally and they agree that they have received very little information on climate change in their training and little or no specific complementary training on the subject outside the university context.

There is a negative and erroneous belief about the fundamental biophysical processes for the development of life on Earth, as is the case of the greenhouse effect or errors in other ideas and para-scientific concepts.

The level of general knowledge about climate change stands out comparatively over other population groups less familiar with the scientific field in line with the available literature. The weight of the common knowledge of climate change is remarkable in the university students surveyed, probably due to the social interactions and informal communication that is generated around this phenomenon. There is a coexistence between the knowledge acquired in higher education and that acquired in non-academic contexts.

Relationship between the water crisis and climate change: the degree of knowledge of students about this relationship is much higher than when studying it by dimensions.

The self-perception of climate change information of university students in the context of contrast does not match the scientific correctness of the responses obtained in their vast majority.

When comparing the three territorial contexts: territory and climate has not an influence on the social representation of climate change.

Finally, we highlight the most relevant aspects of the results of this study:

1. Aspects to be highlighted regarding the Knowledge Branch:

   There are significant differences in general between students belonging to the branches of knowledge of natural sciences and engineering and students of social sciences and humanities, with the former having greater knowledge of the dimensions of climate change studied in this work.

2. Aspects to be highlighted in terms of the degree:

   Degrees that include in their educational offerings subjects that deal with climate sciences, in addition to social sciences, such as the Environmental Sciences degree, increase students' knowledge of climate change somewhat more than in the rest of the degrees.

3. Aspects to be highlighted regarding the course:

   The increase in the number of years of university education does not influence a better climate literacy of the student nor the competence to answer correctly the questions of the questionnaire.

4. Aspects to be highlighted in terms of territory:

   The weight of the common culture around the different aspects of climate change prevails over the influence of the territory.

Although in some aspects, such as the different perceptions of the relationship between the climate crisis and the water crisis, it can be noted in the three territorial contexts analysed, in general, it can be said that university students in these three contexts follow practically the same patterns in terms of the social representation of climate change.

To conclude, we would like to talk about the final considerations and limitations that have arisen in this work. The specific objectives have been achieved as it has been possible to explore the influence of common culture in relation to the variables studied. Important findings have been obtained in terms of understanding how social representations of climate change are formed in university students. In addition, future lines of research may be oriented towards studying how climate change is being dealt with in other university contexts in their curricula. Differences or discrepancies have been found between the theory studied and the data obtained, and it has been possible to determine that there is a relationship between the justification for this research and the results obtained.

With regard to the limitations of the study, it was initially decided to carry out this research, taking only Andalusian university students as a sample for the study, however, the lack of logistical and economic resources did not allow for this. This led to the limitation of the type of study due to the sample. Despite the fact that it was possible to survey a large number of university students, doubts sometimes arose as to whether the sample was representative or not. It should therefore be made clear that this study is, among other things, an exploratory study, which works with non-parametric descriptive statistics and, therefore, by quotas, i.e. it selects a sample from each region to allow comparisons. Another limitation of the study was not being able to make a more exhaustive comparison with respect to the territorial context of the student. That is to say, in this research we were able to work with two universities in the north of the Iberian Peninsula and only one in the south, so if we had had the opportunity to work with another university in the south of the Peninsula it would have been more correct, but the means did not allow it either. However, as this study is part of an international project, future lines of research can address this limitation in order to broaden the focus of the study and the project itself.

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Conflict of interest

The authors declare no conflict of interest.

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