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Environmental awareness and controversy mapping on excessive meat production and consumption.

A study with preservice preschool teachers

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Abstract

The current meat production and consumption model is a socially acute question with environmental implications. Developing people's environmental awareness is necessary for adopting more environmentally friendly eating habits. This work studies the possible effects of a Cartography of Controversy didactic device on the environmental awareness of preservice preschool teachers. Their answers to an open-ended question about their meat consumption were analysed before and after the activity. The results show no significant changes in their willingness to reduce meat consumption after the activity. Health or animal welfare seem to be more relevant reasons for them than environmental ones. However, there is some increase in the environmental reasons following participation in the activity.

Science education, socially acute questions and environmental awareness

In relation to science education, Morin et al. (2017) consider a major purpose of contemporary science education is to prepare citizens to reason and to take part in decision-making processes about environmental socio-scientific issues (SSIs) that impact on our global future. Socially acute questions (SAQs) are one of the "science-in-context" fields that aim to associate scientific education and education for citizenship through the study of socio-scientific/socio-technical controversies or environmental problems (Bencze et al., 2020). According to Simonneaux (2008), SAQs are issues that generate controversy among specialists in the relevant fields, are laden with uncertainty, challenge social practices, are considered a problem by society, give rise to debate, and are the subject of significant media coverage. This means that these issues are alive at three levels: research, society and classrooms. In this sense, some studies show that the treatment of SSIs could benefit the development of the students' environmental awareness. One example can be seen in a work carried out by Susilawati et al. (2021) with 83 preservice science teachers from Indonesia, in which the experimental group (SSI-based instruction) obtained better scores on an environmental awareness test than the control group (direct instruction) after the study. Therefore, SAQs seem to be a good approach to study the influence of the treatment of environmental SSIs on the environmental awareness, specifically in preservice teachers' environmental awareness.

In this work, we address the SAQ of the current meat production and consumption model. This SAQ has shown increasing interest in Spain, which can be seen in its wider presence in the media (Gutián, 2022), given that it has both health (Mozaffarian, 2016) and environmental implications (Mitloehner, 2018). Within this SAQ, different controversies arise, one of them being excessive meat production and consumption. Adaptation and mitigation responses to climate change are strongly influenced by behavioural and lifestyle choices (Prati et al., 2017). In order to adopt more environmentally friendly lifestyles, one goal of environmental education is for people to develop their environmental awareness.

Environmental awareness

In this work, we adopted the theoretical framework developed by Chuliá (1995) for analysing environmental awareness. Chuliá (1995) was the first author to introduce the term

"environmental awareness" in works published in Spain. As the author herself comments, this model was developed based on the theoretical contributions made about the dimensions that constitute environmental awareness and empirical evidence provided by a monographic survey on the environment representative of the entire Spanish population (CIRES, 1994). The author presents the concept of environmental awareness as "an instrument for organising empirical evidence" (Chuliá, 1995, p. 5) on the dimensions it comprises. It is, therefore, a theoretical model obtained from empirical evidence (existing at the time of publication), this being one of the most interesting aspects of this theoretical framework. This modelling character has probably led this framework to be followed, with slight variations, by other authors in Spain (Muñoz, 2012). Some examples of works that use this model in the field of science and environmental education can be seen in Muñoz (2012) and Laso et al. (2019). According to Chuliá (1995, p. 4), environmental awareness is a construct made of five dimensions:

1. Affective dimension: it brings together feelings of concern for the state of the environment, the degree of adherence to cultural values favourable to the protection of nature and the strength of habits of approaching natural spaces.
2. Cognitive dimension: it groups knowledge related to the understanding and definition of ecological problems, the possession of intelligible schemes about possible solutions and those responsible for them, as well as interest in information on the issue.
3. Conative dimension: it encompasses the willingness to act personally on ecological criteria and to accept governmental environmental interventions.
4. Individual active dimension: it includes environmental behaviour of a private nature, such as the consumption of environmentally friendly products, saving scarce resources, separating recyclable waste at home, etc.
5. Collective active dimension: it includes behaviours, generally public or symbolic, expressing support for environmental protection (collaboration with groups and parties that claim to defend the environment, donation of money, participation in demonstrations and protests, "green vote", etc.).

Jiménez and Lafuente (2006) proposed indicators for analysing each dimension of this model, which are also used in this work. In order to align the dimensions proposed by Chuliá (1995) with the indicators proposed by Jiménez and Lafuente (2006), individual and collective behaviours, considered by Chuliá (1995) as two different dimensions, are

presented in this work within the same dimension (active dimension), as other authors have also done (e.g. Jiménez & Lafuente, 2006; Laso et al., 2019). The dimensions and indicators used in this work can be seen in Table 1.

Table 1. Dimensions and indicators for the analysis of environmental awareness proposed by Chuliá (1995) and Jiménez and Lafuente (2006), respectively.

Dimensions (Chuliá, 1995)	Indicators (Jiménez & Lafuente, 2006)
Affective	AF1. Adherence to pro-environmental values, or the extent to which people make an ecological reading of reality.
	AF2. Severity or degree to which the environment is perceived as a problem that requires more or less urgent intervention.
	AF3. Personal concern for the state of the environment.
	AF4. Priority of environmental problems, implying a hierarchical ranking.
Cognitive	COG1. Specialised knowledge of environmental issues, their causes and consequences.
	COG2. Knowledge and opinions on environmental policy.
	COG3. Degree of general information on environmental issues, or the extent to which people show interest and inform themselves through various sources.
Conative	CON1. Willingness to assume costs associated with different environmental policy measures.
	CON2. Willingness to engage in various pro-environmental behaviours.
	CON3. Perception of the effectiveness and level of responsibility of individual action.
Active	AC1. Private environmental behaviour.
	AC2. Public or symbolic environmental behaviour.

Finally, these four dimensions do not necessarily have a direct relationship. For example, the literature on environmental awareness reports that knowledge (included in the cognitive dimension) and concern (included in the affective dimension) about environmental problems are not variables with predictive power over behaviour (Murga, 2008). However, a person who engages in pro-environmental behaviours is also more likely to have pro-environmental attitudes, concern about environmental issues and knowledge about environmental problems (Muñoz, 2012).

Controversy mapping

Cartography of controversy (CoC) is a didactic approach firstly designed for higher education. It is based on the actor-network theory (Latour, 2005), which considers that the construction of social phenomena can be described by the way social actors communicate, cooperate or are in conflict. To do this, it is not enough to observe the actors involved in isolation, and it is somewhat necessary to follow the actors in the chains of translation of

actants, the arrangements and reconfigurations of the collectives that take place in a controversy (Venturini, 2010).

An actant is defined as a human or non-human entity (people, ideas, animals, things, etc.) that intervenes in a dispute and can influence it (Latour, 1996). CoC is a suitable educational approach to address SAQs, given its potential for exploring and visualising complex issues (Latour, 2005; Venturini, 2010). To deal with a SAQ, the CoC approach involves the development of different materials in a project that requires a certain length of time to develop, in which the controversy mapping serves as a graphically interpretable summary of the entire enquiry conducted on that controversy. The objective of controversy mapping is to describe the actants in a controversy, their relationships with each other and the arenas in which they express themselves. Adaptation in secondary education involves rethinking the content of the knowledge taught, the pedagogical support provided, and the production required from students (Authors, 2019). That is why some authors report shorter experiences from this approach, in which controversy mapping is used "as part of everyday classroom settings to explore how students deal with, unravel and communicate the complexity of the controversy" (Christodoulou et al., 2021, p. 4). According to Christodoulou et al. (2021), controversy mapping could have different educational purposes depending on how it is implemented: as a tool for familiarisation, exploration and/or consolidation. The study shown in this paper is part of a larger project which, among other objectives, tries to develop proposals for the inclusion of the CoC approach in shorter teaching sequences that can be applied by teachers who do not have the time to develop a complete enquiry from this approach.

Research question

In this work, we present an adaptation of the CoC approach focusing on controversy mapping as a familiarisation tool. Specifically, we analyse the influence of a controversy mapping activity about excessive meat production and consumption on preservice preschool teachers' (PPTs) environmental awareness. Therefore, the research question is as follows: Are there changes in the PPTs' environmental awareness after participating in an activity based on a CoC device? The researchers' initial hypothesis, based on previous studies (Cruz-Lorite et al., 2021), is that changes might be concentrated to a greater extent in the cognitive and affective dimensions, and to a lesser extent in the conative and active dimensions.

Methodology

This is a non-experimental study with a longitudinal multidimensional ideographic design based on a qualitative methodology of indirect non-participant observation within a mixed approach (Creswell, 2014). It is characterised by the combination of quantitative and qualitative methods, techniques, concepts, or language in a study or series of linked studies (Anguera & Mendo, 2016).

Participants

103 PPTs of two classes (class A, 51 students, and class B, 52 students) participated in this study. They were studying the subject Natural Sciences Teaching in the 3rd course of the Degree in Preschool Education at the University of Málaga during 2019/20. All of them were women, most of them between 20 and 22 years old and studied science for the last time in their compulsory secondary education (15-16 years old).

Learning context

The activity was carried out with each class in three-hour online sessions using the Miro platform (miro.com) to build the maps. This platform allows simultaneous participation of the whole class in an environment that simulates a virtual blackboard. Therefore, each class built one map (Figure 1).

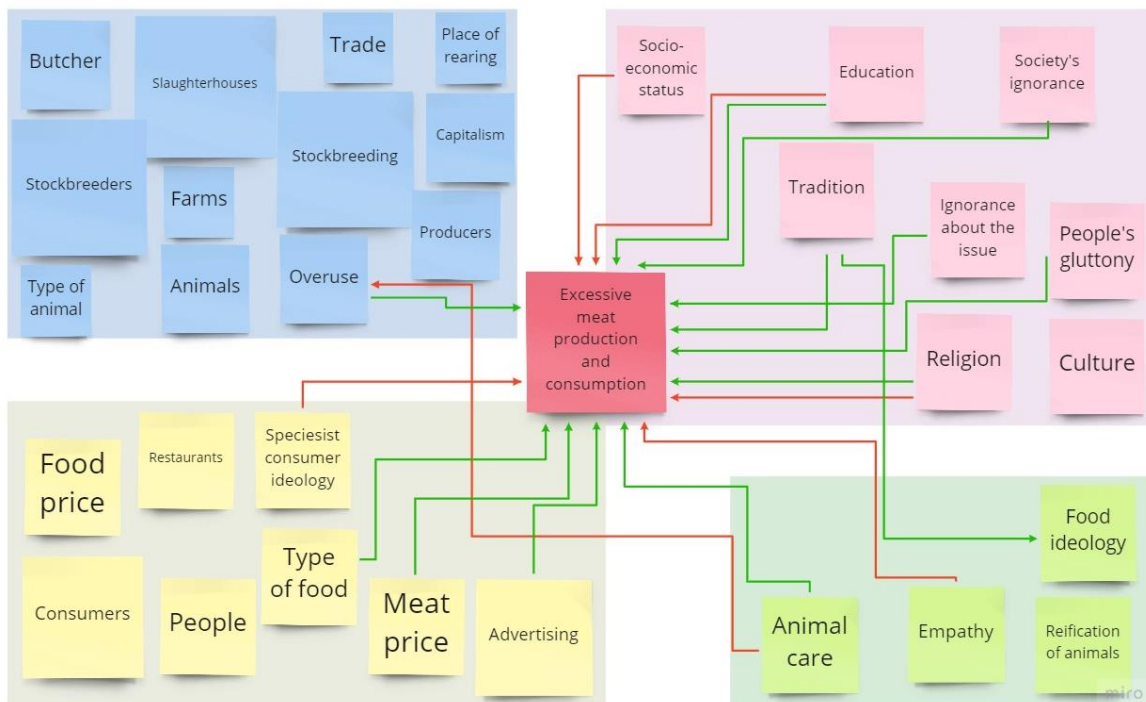


Figure 1. Map built by class A. Colour code: actants in blue, pole "Production"; actants in pink, pole "Society"; actants in yellow, pole "Consumption"; and actants in green, pole "Ethics and morals".

The activity consisted in mapping the PPTs' representation of a controversy. The controversy chosen was the excessive meat production and consumption. First, PPTs were asked individually to think of six actants related to the controversy. Next, PPTs were organised in small groups of 4-5 members to facilitate the process of including the actants on the map. In each of these small groups, the PPTs had to decide which individually proposed actants would finally be included in the map, choosing only the four most relevant ones. When the actants were included in the map, a dialogue was initiated between the teacher and the PPTs to decide how they would be grouped into different poles. The poles are sets of actants that are grouped according to affinity. PPTs were then asked to establish relationships, linking the actants to each other and the central issue of the controversy, in terms of favourable relationships (when one favours or enhances the action of the other) or unfavourable (if one opposes or hinders the action of the other). Finally, students were asked to propose actions to alleviate the problems related to excessive meat production and consumption that had emerged on the map.

Data collection

A pre/post-mixed questionnaire was used for data collection. The questionnaire included questions on environmental awareness and others on the didactic use of controversy mapping. However, only the questions concerning environmental awareness are analysed in this paper.

In the case of environmental awareness, open-ended questions were formulated for two reasons. On the one hand, there is a low specificity in the existing instruments for measuring environmental awareness. Although tests exist to measure environmental awareness, those available for the type of sample studied in this work are general, since they aim to measure environmental awareness in a general way rather than specifically about the environmental problems related to the issue of meat production and consumption. Taking into account that people do not have a generic environmental attitude, as environmental awareness depends on the relevance of specific environmental issues to which they are particularly sensitive (Corraliza, 2002), we decided to use open-ended questions to analyse what elements of environmental awareness PPTs bring into play when answering questions related to their

meat consumption, which is a data collection method already used in other works (Cruz-Lorite et al., 2021). On the other hand, it has been a traditional preference for quantitative measurement of environmental awareness (e.g. European Commission, 2017; Junta de Andalucía, 2018; Laso et al., 2019). In this sense, Cerrillo (2010) attributed the stagnation suffered by environmental sociology in recent decades, among other factors, to the preference for quantitative methodologies, specifically through the use of surveys, as the results obtained from these did not cease to come up against the inconsistency between declared attitudes and manifest behaviours (the so-called "environmental gap"). For both reasons, we consider that the study of environmental awareness on specific problems requires other methods and instruments more adapted to the specific characteristics of these problems, which can also be complemented by information provided by more generic methods.

In conclusion, the impossibility of using a valid and reliable quantitative instrument led us to consider the use of a qualitative methodology based on a well-established theoretical model, such as that of Chuliá (1995), with the advantage that specific indicators for the characterisation of each of these dimensions had already been proposed (Jiménez & Lafuente, 2006). For all of the above reasons, it was decided to ask an open-ended question in the pre-test, with a sufficiently broad formulation to allow us to study what aspects of environmental awareness, if any, arose spontaneously from the PPTs when dealing with the controversy over meat consumption. This question was: Would you be willing to reduce your meat consumption? Please explain and substantiate your opinion in detail. In the case of the post-test, an open-ended question was also asked. However, in this case, the question was rephrased. Considering the low probability that a single activity would substantially change the opinions of the PPTs, it was to be expected that many PPTs would provide the same answer in the post-test as in the pre-test, that they would indicate that they thought the same as before the activity, or that they would simply not answer. To avoid this, as far as possible, the question was rephrased by appealing to those specific aspects of their opinion on the controversy that might have been affected. Thus, the question was: Have your initial views on reducing meat consumption changed in any way? If so, please explain and substantiate your opinion.

Data analysis

The PPTs' responses were analysed regarding their position on the question (willingness or unwillingness to reduce meat consumption) and the reasons they provided. The responses were analysed qualitatively using the software Atlas.ti v.9. In the case of the reasons, they were thematically categorised by an open-coding process, obtaining a system of 15 categories (Table 2). The environmental reasons were grouped into the category "Environmental", and in these cases, the environmental awareness analysis was applied using the indicators of Jiménez and Lafuente (2006) (Table 1). An example of the analysis can be seen in Figure 2.

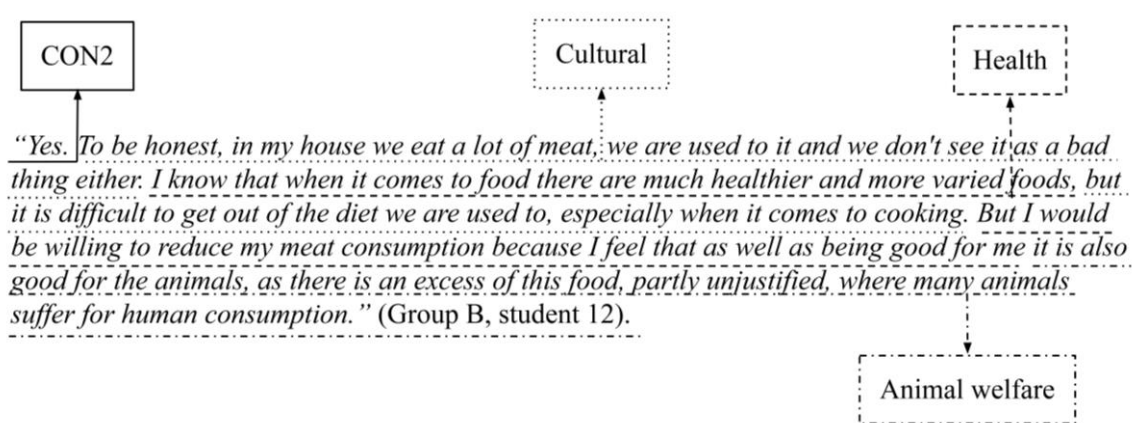


Figure 2. Example of the analysis of a response.

The "Environmental" category included those reasons that alluded to issues related to environmental awareness, as understood in the Chuliá's (1995) model, on environmental problems related to the current and dominant meat production and consumption model. That is, those that included knowledge, affective issues, attitudes or behaviours in relation to environmental problems directly related to the SAQ addressed. Categories such as "health" or "cultural", for example, include reasons about human health associated with meat consumption or consumption habits and traditions around meat, respectively, but do not show knowledge, affective aspects, attitudes or behaviours in relation to environmental problems derived from the SAQ. It should be noted that the categories "Endangered species" and "Population control", despite being related to environmental problems and issues, have not been considered environmental reasons related to the SAQ, since the responses included in these categories assumed that human meat consumption is largely based on hunting and that this activity would be mainly responsible for: 1) the existence of endangered species, and 2) the population control of species in the wild. These reasons are to some extent far

removed from the environmental problems directly related to the dominant industrial model around meat (at least in Western countries), in which animal production, and not hunting, is what sustains most consumption (Sevillano et al., 2018; Subdirección General de Producciones Ganaderas y Cinegéticas, 2021).

Table 2. Obtained categories from the reasons analysis and their descriptions.

Category	Description (topics of the reasons included in each category)
Health	Eating (or not) meat is healthy/natural; nutrients in meat can be obtained from other foods, healthy preparation methods and risk of diseases.
Animal welfare	Animal mistreatment, make animals freer, feelings of guilt, give animals a dignified death and animals are fed unhealthy food.
Taste of food	Taste of meat and vegetables.
Balanced diet	Reasons that they already have (or do not have) a balanced diet and do not (or do) need to reduce their meat consumption.
Environmental	The meat industry pollutes, meat consumption accelerates climate change, population increase makes meat consumption unsustainable, actions to minimise pollution and buy other types of products.
Cultural	Meat consumption is part of our culture/traditions/habits and restaurants do not have vegetarian/vegan food.
Economic	Many jobs depend on meat, meat is cheap, vegetarian/vegan products are expensive.
Meat quality	Meat currently lacks quality and intention to consume only quality meat.
Endangered species	Meat consumption affects endangered species.
Population control	Hunting is necessary for population control.
Extreme necessity	They would only stop eating meat in case of extreme need (without specifying), or there was no way of supplying the population.
Criticism of vegans/vegetarians	Vegetarians/vegans view people who eat meat negatively.
Media	Need to be well informed.
Physical appearance	Higher meat consumption is associated with weight gain.
No precise topic	Get to see the problem from other perspectives or consider other actants to analyse it, but without specifying which ones.

Results

79 PPTs answered both pre and post-test. The PPTs provided 188 reasons in their answers in the pre-test and 70 in the post-test, and they were given to justify both willingness and unwillingness to reduce meat consumption. Responses could have several reasons of

different types, so the sum of reasons is not equal to the total of the sample. The reasons provided by the PPTs can be seen in Table 3.

The main reasons provided in the pre-test were about health, animal welfare, food taste, a balanced diet (which is significantly related to health), environment and cultural aspects. In the post-test, the main reasons were about health, balanced diet, environment, animal welfare, cultural aspects and meat quality. Of the number of reasons given in the post-test (70), 31 were new compared to those shown in the pre-test. Practically all the environmental reasons given in the post-test, as well as those related to a balanced diet, are reasons provided by PPTs who did not take these reasons into account in their pre-test responses. As noted above, one response could include several reasons, so the 10 new environmental reasons in the post-test correspond to 8 PPTs. Finally, some categories only appear in the pre-test (taste of food, endangered species, population control, extreme necessity, criticism of vegans/vegetarians and media) or the post-test (physical appearance and no precise topic).

Table 3. Results of the analysis of the reasons found in PPTs' answers. The first post-test column shows data in the way "n(x)", being "n" the total number of reasons in the post-test and "x" the number of new reasons with respect to the pre-test.

Category	Pre-test		Post-test	
	n	%	n(x)	%
Health	55	29.3	18(3)	25.7
Animal welfare	28	14.9	7(4)	10.0
Taste of food	28	14.9	0(0)	0.0
Balanced diet	23	12.2	11(8)	15.7
Environmental	18	9.6	11(10)	15.7
Cultural	17	9.0	3(2)	4.3
Economic	6	3.2	1(1)	1.4
Meat quality	4	2.1	3(2)	4.3
Endangered species	3	1.6	0(0)	0.0
Population control	2	1.1	0(0)	0.0
Extreme necessity	2	1.1	0(0)	0.0
Criticism of vegans/vegetarians	1	0.5	0(0)	0.0
Media	1	0.5	0(0)	0.0
Physical appearance	0	0.0	1(1)	1.4
No precise topic	0	0.0	15(15)	21.4
Total	188	100.0	70(46)	100.0

The results about the environmental awareness aspects found in the environmental reasons can be seen in Table 4. Responses about the willingness or unwillingness to reduce meat consumption are related to the willingness to engage in a pro-environmental behaviour (indicator CON2), and responses that said they had already reduced their meat consumption

(e.g. vegetarian or vegan) are related to a private environmental behaviour (indicator AC1). However, these have not been accounted for in Table 4, because these were not questions that arose spontaneously from students giving their opinion, but rather this information was requested directly in the question (Would you be willing to reduce your meat consumption?). For this reason, the answers directly related to the question posed were not mixed with other information that the PPTs could offer on these indicators. Below is an example of a response classified in indicator CON2 (included in Table 4) which is not directly related to the question posed:

"Perhaps I would not change the amount of consumption itself because as I said it was not very high, but I would change the way of doing it or the product to buy."

(Class B, student 9)

This answer is about the possibility of changing the type of meat product purchased, which is a willingness to engage in another type of pro-environmental behaviour, not necessarily reducing meat consumption.

Regarding the willingness to reduce meat consumption (results not included in Table 4), before the activity: 37 of the PPTs were willing to reduce their meat consumption, 25 were unwilling to reduce it and 1 answered that she was unsure (conative dimension). The rest did not answer the question clearly. Both groups (willing/unwilling) were similar regarding the reasons provided in their answers, but they show differences in animal welfare (providing 19 and 4 reasons, respectively) and environmental (17 and 5 reasons, respectively). 16 PPTs said they had already reduced their meat consumption or tried to reduce it (active dimension), mainly for health (13) and animal welfare (11) reasons. After the activity, 21 PPTs said that they had changed their initial opinion somewhat, and 56 did not. The PPTs who changed their opinion after the activity provided mainly reasons on health (15) and animal welfare (9). Furthermore, PPTs who answered in the pre-test that they had already reduced their consumption or tried to do so reinforced their positions after the activity.

Regarding the rest of the environmental awareness aspects found in the PPTs' answers (Table 4), the environmental reasons given in the pre and post-test belonged mainly to affective (pre-test = 10; post-test = 6) and cognitive (5; 3) dimensions. Reasons related to the affective dimension are mainly about their personal concern for the environment (AF3). In the case of the cognitive dimension, in both pre-test and post-test, some PPTs show specialised knowledge of the environmental implications of the controversy (COG1). However, they do not show opinions on environmental policies (COG2). Regarding the conative dimension,

only three reasons (2; 1) indicated the willingness to assume costs from environmental policy measures (CON1), and there were only two reasons (1; 1) about the willingness to carry out individual pro-environmental behaviour different from reducing meat consumption (CON2) (see example of student 9, Class B). None of them shows opinions related to the individual effectiveness or responsibility of their actions (CON3). Regarding the active dimension, no other individual behavioural alternatives different from reducing meat consumption (AC1) or collective behaviours (AC2) were provided.

Table 4. Results of the analysis of environmental awareness in pre- and post-test. The first post-test column shows data in the way "n(x)", being "n" the total number of reasons in the post-test and "x" the number of new reasons with respect to the pre-test.

Category	Subcategory	Pre-test		Post-test	
		n	%	n(x)	%
Affective	AF1. Adherence to pro-environmental values, or the extent to which people make an ecological reading of reality.	1	5.6	1(1)	9.1
	AF2. Severity or degree to which the environment is perceived as a problem that requires more or less urgent intervention.	1	5.6	0(0)	0.0
	AF3. Personal concern for the state of the environment.	7	38.9	5(4)	45.5
	AF4. Priority of environmental problems, implying a hierarchical ranking.	1	5.6	0(0)	0.0
Cognitive	COG1. Specialised knowledge of environmental issues, their causes and consequences.	4	22.2	3(3)	27.3
	COG2. Knowledge and opinions on environmental policy.	0	0.0	0(0)	0.0
	COG3. Degree of general information on environmental issues, or the extent to which people show interest and inform themselves through various sources.	1	5.6	0(0)	0.0
Conative	CON1. Willingness to assume costs associated with different environmental policy measures.	2	11.1	1(1)	9.1
	CON2. Willingness to engage in various pro-environmental behaviours.	1	5.6	1(1)	9.1
	CON3. Perception of the effectiveness and level of responsibility of individual action.	0	0.0	0(0)	0.0
Active	AC1. Private environmental behaviour.	0	0.0	0(0)	0.0
	AC2. Public or symbolic environmental behaviour.	0	0.0	0(0)	0.0
Total		18	100.0	11	100.0

Discussion and conclusions

Before the activity, almost half of the PPTs (46.84%) were willing to reduce their meat consumption. A fourth of them (20.25%) had already reduced their meat consumption or tried to reduce it. Regarding the reasons provided, the PPTs willing to reduce their meat consumption mainly provided animal welfare and environmental reasons. The PPTs who had reduced or tried to reduce their consumption provided health and animal welfare reasons. So, these two last categories seem to be the most important aspects in their opinion changes. In general terms, most of the PPTs' justifications were based on health reasons, in both pre- and post-test, which seems to be the most important aspect for them in dealing with the controversy. Before the activity, aspects such as animal welfare, food taste or balanced diet seemed more relevant for the PPTs than the environmental issues. Furthermore, the limited environmental reasons provided were focused on AF3 and COG1 indicators before and after the activity. These results show that environmental issues are not a priority for these PPTs when it comes to expressing their opinion on the controversy.

In general, related to the PPTs' reasons, these results reflect to some extent the inconsistency between environmental knowledge, the attitudes declared by individuals and their actual behaviour, the aforementioned "environmental gap" (Kollmuss & Agyeman, 2002). In this regard, Murga (2008) argues that knowledge and concern about environmental problems would not be variables with predictive power over behaviour. The difficulty in explaining pro-environmental behaviour based on environmental knowledge has led to the emergence of pro-environmental models that incorporate other aspects that could have a determining influence on environmental awareness, such as moral (Schwartz, 1970) or social norms (Farrow et al., 2017). These moral and social aspects could be represented in this work in the high frequency of the categories "Taste of food" and "Cultural", in the first case, and "Animal welfare" in the second one.

More specifically, related to the environmental reasons, Macdiarmid et al. (2016) conducted a study to explore public awareness of the environmental impact of food and willingness to reduce meat consumption with twelve focus groups involving 83 people. Their results reported that the environmental impact of meat production or its contribution to climate change is rarely mentioned spontaneously. This study provides evidence that public opinion on meat consumption is associated with significant personal, social and cultural values. Taking this into account, and the results obtained in this work, one of the implications for qualitative instruments designed to collect information on environmental awareness, in this

case from PPTs, is that they should explicitly require information about certain environmental aspects.

However, we found a slight increase in the number of environmental reasons after the activity, as 10% of the PPTs who did not consider environmental aspects when giving their opinion on the controversy before participating did include them after the activity. Furthermore, some categories in the pre-test that seem to show naïve ideas about the provenance of the meat consumed by people, such as endangered species and population control, did not appear in the post-test. However, it does not mean that these ideas have been abandoned by the PPTs who provided them in the pre-test. In addition, some PPTs that had adequately justified their answers in the pre-test did not do so in the post-test, with answers being classified in the category "No precise topic". One aspect that may have influenced the occurrence of this type of response is that it was a demanding but non-assessable activity, so PPTs may have relaxed at the end of the activity. In addition, the fact of having to answer the same question twice may have had a demotivating effect on some PPTs, who answered more vaguely on the post-test.

Finally, we conclude that the results show that the CoC device affects the PPTs' environmental awareness even if it is used as a familiarisation tool with a SAQ, but in a very limited way, given that, after participation in the CoC activity, the number of new students providing environmental reasons is low, and their reasons are related to some specific aspects of the affective and cognitive dimensions. The main limitation of this study is the scant capacity of a single open-ended question to gather exhaustive information. This limitation has been noted in the case of information on the PPTs' environmental awareness, although it does not seem to have affected all topics similarly. For that reason, we intend to use these results to develop a more complete instrument in future works. Moreover, one perspective of this work is to understand whether the constructed maps and, in particular, the identified actants allow for developing specific dimensions of the PPTs' environmental awareness. It should also be noted that the validity of the results obtained is limited to the analysis of the effects of the mapping of the PPTs' representation of the controversy, and not to the controversy mapping (Latour, 2005; Venturini, 2010). For this reason, in future experiences, it is intended that PPTs build their map from a corpus of documents.

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