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Citizen awareness of the risks of flooding: the importance of teacher training

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ABSTRACT
Natural risks linked to climate change have become a priority issue for the international community. The objective of this research is to evaluate to what extent Social Science teacher training and didactic activities to teach about floods are adequate to meet the challenge based on the social representation of teachers in training and active Social Sciences teachers. Data were obtained through a mixed questionnaire from a sample of undergraduate and postgraduate trainee teachers from several Spanish universities, and practicing secondary education teachers (N = 784) (between 2018-19 and 2022-23). The results reveal little or no training of the participants on climate change, natural disasters and floods throughout their careers, with the exception of postgraduate students who graduated in Geography. Likewise, there is a negative perception in relation to their training to teach these topics in the classroom, a limited diversity of didactic proposals and classroom strategies for their treatment in class, instead perpetuating those of a traditional and transmissive nature. In conclusion, the need to improve teacher education and training on climate change and its associated natural risks is confirmed in order to contribute to an improvement in socio-territorial resilience and the formation of an active and participatory citizen consciousness.

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Introduction

Worldwide, floods constitute episodes that, due to their magnitude and destructive potential, put human lives and material structures at risk, while being characterised by their complex prediction (Pérez-Morales et al., 2022). Without a doubt, understanding the flood-generating process as well as identifying the signals of climate change are crucial for quantifying risks and mitigating disasters in the future (Tellman et al., 2021). When talking about natural risks, we must not forget that the deaths are due to both dangerous factors (the atmospheric event) and the exposure of the population (Pérez-Morales et al., 2022).

In the Mediterranean area (study area), these extreme events are linked to atmospheric behaviour that has been developing with higher frequency and intensity in recent years (Meseguer & Olcina, 2023). These effects, furthermore, are processes that, as indicated by the Intergovernmental Panel of Climate Change (IPCC, 2022), will become increasingly intense and frequent.

In the world, according to the Centre for Research on the Epidemiology of Disasters (CRED, 2022), between 2001-2020, floods have been the most frequent natural risk and the one that affects the most people around the world (82.7 million inhabitants). As for fatalities, floods cause the most deaths ditto. For example, globally, in 2021, 4,143 deaths were recorded due to these phenomena (39.4% of the total natural disasters), with India (1,282 deaths), China (352 deaths) and Afghanistan (260 deaths) being the countries with the highest number of deaths. In relation to economic damages, a total of USD74.4Bn has been recorded (29.5% of the total), with China (15.5 billion) being one of the countries with the greatest losses. Therefore, developing countries are the most exposed in terms of suffering fatalities, while developed countries are the most vulnerable in terms of material-economic damage.

In Europe, between 1980 and 2022, floods accounted for 44% of the economic damage caused by natural disasters (509,437 million euros) (EEA, 2022). For Horizon 2100, the JRC has estimated that these phenomena could cause annual losses of 16Bn in the event of a temperature increase of 1.5 °C, and 40 billion in the "non-adaptation" horizon." (>3 °C). For its part, the IPCC, already in its Fifth Report (IPCC, 2014), estimated that, in the European region, the number of annual victims of these disasters could rise to 300,000, and to 390,000 from 2080.

Regarding Spain, Olcina (2020) has calculated that 2 million people reside in places at high risk of flooding. Between 2000-2020, 215 deaths have been recorded due to these phenomena, representing 20% of the total number of deaths, with the Mediterranean coastal region being the most affected (Ministry of the Interior, 2021). In the Valencian Community (study area), it is worth noting that the Territorial Action Plan on Flood Risk Prevention (PATRICOVA) (Department of Territorial Policy, Public Works and Mobility, 2015), estimates that 12% of the population (600,000 inhabitants) reside in a flood zone.

To mitigate the effects of floods, apart from structural and territorial planning measures, different studies (Morote & Olcina, 2023; Sánchez-Almodóvar et al.,2023) show that the education factor should be an action of first order to reduce social vulnerability to these episodes. In this way, greater territorial resilience could be achieved in the current context of climate change. In this regard, Toma et al. (2021) explain that floods, in different countries, during recent decades and due to their consequences, have led to a reconsideration of an increase in social responsibility, from an approach in which awareness and the involvement of society play a role. crucial to avoid human loss and material damage. However, in the Spanish case, different investigations (Morote & Olcina, 2023; Sánchez-Almodóvar et al., 2023) show that education and awareness of climate change and natural risks are not playing a prominent role in the design of prevention policies.

The United Nations Development Programme (UNDP, 2015), with the so-called Sustainable Development Goals (SDGs) (Agenda 2030), gives relevance to raising awareness and training in society about climate change and its associated effects (goal No. 13 "Action because of the weather"). Likewise, it is worth noting that only 2 years ago, in Spain, the Climate Change Law (Law 7/2021, of May 20, on climate change and energy transition) has been approved (Ministry of the Presidency, Relations with Cortes and Democratic Memory, 2021), where several references to the teaching of this phenomenon are inserted (Title VIII "Education, Research and Innovation in the fight against climate change and the energy transition").

Teaching about flooding is of interest for several reasons. Firstly, for the work of raising awareness among citizens to understand the ongoing global changes in relation to climate. In this sense, climate change and its associated effects, in the case of floods (object of study), will have to be increasingly taken into account in education. Secondly, the role that said education plays in the prevention of natural disasters. A society better trained in these issues will be a more resilient society to the already proven effects of climate change. And, finally, the importance of teacher training. This is one of the basic pillars where change can begin.

Literature Review

Citizen Awareness for Change

The involvement of citizens in social and environmental problems is postulated as one of the keys to mobilising change in the way public organisations and governments act (Axon, 2016). Public citizen participation refers to various types of activities that are carried out to incorporate people's interests, concerns and values in decisions on diverse and public issues (Khatibi et al., 2021). Engaging society to address different issues related to the environment and its consequences has the potential to overcome barriers to action where other individualistic approaches have failed (Gómez et al., 2021; Peters et al., 2013). Thus, in crisis situations caused by humans such as the sinking of the oil tanker "Prestige" off the coast of northwest Spain in 2002 or problems generated by natural causes such as the tsunami that devastated areas of Southeast Asia in 2018, citizen activism is postulated as a tool to implement said change. To ensure that public participation is objective, committed and based on critical thinking, it is essential that the population has correct training. It is from this educational level that an adequate and diversified structure of participation is fostered (Norris, 2002). Although these approaches and reflections seem like a novelty of the 21st century, they are actually built on Piaget's postulates of knowledge and learning from the late 20th century. In them, it was recognised that the assimilation of the human context−understood as internal mental schemes−and the adaptation to said context−or relationship with the external physical and social world−constitutes knowledge "originated by intentional human action, that is, interested or with emotion, and transformative or creative" (Hernández & Pacheco, 2017; 38). In this way, knowledge becomes the result of the mental relationships that the subject establishes with the world around him. These relationships, when materialised in actions that have intentionality, become intelligent practices that are aimed at achieving specific goals (Romero, 2021). It is here where citizen awareness and social participation acquire their importance and offer an external route for the proposal of change.

But adequate community involvement is not possible without an understanding of reality. This is where the education and training of citizens and, therefore, of teachers, who constitute a key element, linking scientific knowledge with the knowledge acquired through the process of didactic transposition, the core of the binomial becomes relevant Teaching-Learning (T-L) (Trejos, 2023).

As Morote & Olcina (2024) show, education is a first-order action to reduce social vulnerability to natural risks and in this way, achieve greater socio-territorial resilience to climate change. The floods that have occurred in many countries in recent decades and their effects have led, in the face of an increase in social responsibility, to a new approach: flood risk management through awareness and participation of society, since they play a crucial role in avoiding human and material losses.

The Importance of Education for the Prevention of Natural Disasters

Education is key in the formation of 21st century citizenship. In particular, preparing for and managing the effects of climate change have become a collective risk management challenge (Rumore et al., 2016). This is where education becomes important with the intention of responding to risks as they arise with the intention of adaptation to the enormous variety of challenges linked to climate change. This is not a mere technical challenge, but a broader problem that concerns governments, politics, the economy and, without a doubt, society as a whole (Ojala, 2023).

Although the nature of education about climate change and its associated effects is enormously complex, educational regulations insist that the teacher's task is to train citizens to understand concepts such as greenhouse gas emissions, pollution, historical climate changes, acceleration of this process due to anthropogenic causes, etc. In European countries, these scientific contents are postulated as essential in citizen education and are linked to a catastrophic perception, latent among some teachers, generating an effect of anxiety and concern among pupils (Baker et al.,

2021). This negative perception can be a resource to capture the attention of pupils, promoting their critical reflection on what to do to confront climate change (Ojala, 2023). Also, it can serve to transform the current pedagogies and teaching methodologies proposed in classrooms at basic and post-basic educational levels such as Primary and Secondary Education. This represents a change in the educational paradigm, as proposed by the current Organic Law 3/2020, of December 29 (LOMLOE, 2020), which proposes transformative and interdisciplinary learning through the design of learning situations.

As other authors point out (Shapiro et al., 2017), information alone about the concepts and effects of climate change is not sufficient for awareness and action. In addition to learning the meaning of certain concepts, it is essential that knowledge be accompanied by beliefs, intentions and motivation to achieve the transformation and thinking of school learners.

In the specific case of floods as a direct consequence of climate change, training of citizens in key aspects such as danger detection and training in the procedures to follow in the event of a flood becomes essential. In this sense, it is worth highlighting that in recent years different works on education and teaching about floods and flooding have been published; in North America (Gary et al., 2014; Lee et al., 2019), Asia (Azmi et al., 2020; Shah et al.,2020; Zhong et al., 2021), South America (Thomas, 2011), and Africa (Bernardino et al., 2021). In Europe, it is worth highlighting the contributions of Toma et al. (2021) or Williams et al. (2017). In the Spanish case, this topic has had a greater prominence from the didactics of natural sciences (Díez-Herrero et al., 2021), with the works from the didactics of geography being scarce and recent for example, it is worth mentioning the studies by Cuello & García, (2019), Morote & Gómez-Trigueros (2023), Olcina et al. (2022) and Sánchez-Almodóvar et al., (2023).

The interest of the research presented here has, as its starting point, the current context linked to: the risk of flooding as a natural hazard that affects the Mediterranean region (Pérez-Morales et al., 2022); the increase in the periodicity of this type of episodes as a consequence of climate change (IPCC, 2022); the scarcity of research on didactics of natural risks in Spain; the importance of the "education" factor, since this is a non-structural measure, traditionally disregarded to reduce socio-territorial vulnerability (Morote & Olcina, 2023; Sánchez-Almodóvar et al., 2023); the prescription that, from the current Education Law (LOMLOE, 2020) indicates that the risk of flooding is an educational content that must be addressed from the geographical discipline school; and the importance of raising awareness and teaching younger cohorts about these phenomena, since they will be the ones who teach and raise awareness among future generations (Olcina et al., 2022).

Teacher Training in Natural Risks

Teaching natural risks appears as one of the tasks of teachers in primary education and post-compulsory secondary education in the subject area of Natural Sciences and also in Social Sciences, specifically in the subject of Geography. It is from this subject that pupils can be taught to understand and analyse the effects of natural risks, such as floods (Souto, 2018). Also, from a geographical education that takes into account the environment in which the students develop, it improves the understanding of the environment and manages to transform the perception and behaviour of citizens towards a sustainable local vision (Barratt & Hacking, 2000).

Although such knowledge about basic, key content related to climate change and natural risks is assumed by teachers (Morote & Gómez-Trigueros, 20203: Sánchez-Almodóvar et al., 2023), the reality of the educational context shows another aspect. On the one hand, in the Master's degree studies in primary education, there is eminently superficial training on these topics, focused primarily on the consequences, and little or nothing on the processes that give rise to these phenomena. In the case of students for the Master of Secondary Education, there is a high percentage of history graduates, who lack training in these contents (Morote & Gómez-Trigueros, 2023). Thus, there is still a need to enrich and improve teacher training in basic content, related to knowledge about problems, causes and effects of natural risks. Likewise, and related to theoretical preparation, preparation and

training in the development of strategies related to how to approach these contents and with what tools is essential (Sánchez-Almodóvar et al., 2023), so that they are comparable with the training of students at all basic educational levels. It is also confirmed that, in many cases, teachers limit themselves to reusing resources and information present in the media, without a scientific basis and based on alarmism, generating a poor understanding of these phenomena (Morote et al., 2021). This has clear consequences in the imagination of the student body, future citizens, who approach natural risks and their consequences from a superficial and erroneous vision.

Most studies and works are based on an observation of the curricula of the different educational levels (Sánchez-Almodóvar et al., 2023), the study plans and the subject teaching guides (Filho et al., 2019; Parker & Muñoz, 2012), without taking into account the perception of teachers in training and active teachers, in relation to their preparation to teach this content. Therefore, the objective of this research, based on representative samples of teachers in training (degree in primary education and Master's in secondary education from several Spanish universities), and active teachers of the Valencian Community (Spain), is to analyse the perception they have about the training received, teacher training and didactic proposals to teach floods. To this end, a study instrument has been designed, which seeks to ascertain the following

- Research Objectives1 (RO): perception of the training received in content related to floods and natural risks of teachers in training (TT) and active teachers (AT)
- RO2: perception of the training received in strategies for teaching content related to floods and natural risks of the TT and AT
- RO3: perception of specific didactic proposals for working on content on floods and natural risks in the TT and AT classroom.

Based on these study objectives, two working hypotheses have been designed: the first initial hypothesis (H_1) of this research is that teachers in training and in active service lack training throughout their preparation as teachers, to the work on content related to floods and natural risks, with the exception of those who are graduates in Geography; The second starting hypothesis (H_2) is that teachers tend to use classic visual resources (documentaries, videos) to teach content related to floods and natural risks compared to other more dynamic proposals, with active and meaningful methodologies.

Methods

As already noted in the theoretical framework of this manuscript, most research has focused on the analysis of the causes of climate change and the study of global emissions and pollution (IPCC, 2022). Also, there are studies on education and consequences of climate change (Lee et al., 2019; Azmi et al., 2020; Shah et al., 2020; Zhong et al., 2021) and their importance for citizen education. However, these studies do not analyse the training and perception that future teachers have about their preparation to address this topic in the classroom. In the case of Spain, the work focuses on descriptive analyses from a technical perspective associated with flood risk prevention institutions. The novelty of this work is to show the perception of active teachers and teachers in training about their preparation in content and their training for the design of didactic proposals to address natural flood risks such as consequence of climate change in the Mediterranean area of Spain.

Research Design

This research is a mixed-type (non-experimental) explanatory and correlational study, based on the use of the mixed-type questionnaire as an instrument for collecting information (Gómez-Trigueros, 2024). The selection of this research design is given by the structure of the research in which, due to temporal logistics and the availability of the sample, it is limited to a study that is based on descriptive analyses (mean and standard deviation) and that progresses towards the achievement of inferential results (non-parametric Kruskal-Wallis H statistics, contingency tables among others),

which allow responding to the objectives of the research. Regarding the temporal dimension, its design is transversal since the information obtained has been collected at different specific moments, throughout five academic years (between 2018-2019 and 2022-2023).

Context and Participants

The selection of participants has been carried out through non-probabilistic sampling (available or convenience sampling). The participants in this research have been both teachers in training (students for the degree in primary education Teacher and Master's degree in secondary education - specialisation in Geography and History), and active teachers from the Valencian Community (Spain), who have completed the "Didactics of Geography" workshop. Teaching resources and proposals in the face of new global challenges", organised by the Teacher Training Centre (Activity organized by the Autonomous Secretariat of Education and Professional Training of the Department of Education, Culture and Sports, within the Continuing Teacher Training Plan).

The participating sample was made up of 784, out of a total of 978 registered men and women (*N*=978), distributed as follows: degree in primary education teacher (DPT) (*n*= 695); Master's degree in secondary education teacher (MST) (*n*= 200); and active teachers (AT) (*n*=83). This figure (*N*=784) (Table 1). In relation to gender composition, the number of women is higher than that of men, with a representation of 66.2% (*n*= 519). And regarding age, the average amounts to 23.9 years (Table 1).

Regarding the disciplinary training of the students for the Master of Secondary Education, it is worth noting that the majority are graduates in History (61.2%; n= 79), followed by Art History (24.0%; *n*=31), Geography (9.3 %; *n*= 12), and other studies other than those mentioned (Humanities, Tourism, Law, etc.) (4.7%; *n*=6). Regarding the active Secondary Education teachers, it is also worth highlighting the graduates in History (45.8%; *n*= 27), Geography (27.1%; *n*=16), Art History (18.6%; *n*= 11) and other related studies (8.5%; *n*= 5).

Table 1

Training and active teaching staff who have participated in the research

	Inscribed	Participants	Gender			
			Male	%	Female	%
DTP	695	596	445	56.7	151	19.3
MTS	200	129	53	6.7	76	9.6
AT	83	59	21	2.8	38	4.9
Total	978	784	519	66.2	265	33.8

Note. DTP= Degree in Primary Education Teacher; MTS= Master's Degree in Secondary Education Teacher; AT= active teachers.

Research Instrument

The research instrument consisted of a questionnaire used in previous works (Morote & Gómez-Trigueros, 2023). This questionnaire has a total of 38 items and is structured as follows: block l) on the socio-educational characteristics of the participating sample (items 1-4); block 2) issues related to the risk of flooding in the space close to the participants in the study such as their municipality (items 5-10); block 3) questions related to flood episodes in the educational centres where they have studied or work (items 11-16); block 4) related to the training received on flood risks during the school stage (items 17-21); 5) items about their perception in relation to the risk of flooding in their nearby geographic spaces (items 22-25); and 6) questions related to the teacher training received regarding concepts, training and classroom strategies to work on flood risk in primary and secondary classrooms (items 26-31). For this research, and taking into account the proposed objectives and the designed hypotheses, different items from block 6 have been analysed: items 26 and 27 (OB1), items 28 (OB2), item 30 and 31 (OB3) (Annex).

It should be noted that the questionnaire has been validated by experts, with knowledge of the contents addressed in this research, as well as experience in teaching at educational levels of Primary, Secondary and university education. The process followed for said validation has been the Expert Panel method (Table 2).

Table 2

Professional characteristics of the expert group

Professional category	Knowledge area	Workplace	Years of experience
Professor	Didactics and School Organisation	University of Oporto	30
Senior Lecturer	Didactics and School Organisation	University of Cuba	18
Senior Lecturer	Educational Pedagogy	University of Ecuador	15
Senior Lecturer	Didactics of Social Sciences	University of Spain	11
Elementary School Teacher	Degree in primary education	Public School Spain	12
Elementary School Teacher	Degree in primary education	Public School Spain	10
Elementary School Teacher	Degree in primary education	Public School Spain	9
Secondary Education Teacher	Master's degree in Secondary Education Teacher	Public Secondary School Spain	8
Secondary Education Teacher	Master's degree in Secondary Education	Public Secondary School Spain	7

Once the panel was formed, they were invited to participate in the validation process, through an email where they were informed of the objectives of the research, the composition of the sample and the instrument configured by the researchers. They were also sent a form to evaluate the instrument and they were asked to submit their answers within a maximum period of two weeks. After that time, the experts issued their judgments, on a 5-point interval scale, on the relevance and adequacy, internal coherence and importance of the questions they intended to ask. Likewise, they were asked for a general assessment of the construct on a scale of 1 to 5 points. After administering the evaluation instrument in two rounds, the responses of the group of experts were obtained. The final results obtained show a mean greater than 4 in the general assessment of the questionnaire and a low dispersion of the responses regarding the relevance and adequacy (M = 4.5; SD = 0.18) and the internal coherence of the instrument (M = 4.8; SD = 0.21). Likewise, a general value was obtained for the reliability and internal consistency of the entire scale (α = 0.933). It should be noted that the questions related to the adequacy of the questionnaire to the research objectives obtained a value greater than 0.9 (α = 0.901).

To evaluate construct validity, several procedures have been carried out. Firstly, a statistical analysis of the ordinal variables has been carried out. For these variables, it was found that there was an acceptable standard deviation, since the value obtained was between 0 > 1. Secondly, the construct was subjected to the Kaiser-Meyer-Olkin (KMO) validity test, which indicates whether the factor analysis of the instrument is acceptable or not. The KMO test offers a positive result of 0.498 which, according to other factor reliability studies, is considered an acceptable level (Pérez-Gil et al., 2000). Thirdly, as it is a mixed questionnaire (quantitative and qualitative), the Friedman Chi-square test (Friedman's $\chi 2$) has been carried out. This test offers a positive value of p= 0.001, far from zero (p< 0.05). This gives a positive value of reliability to the research as has been shown in other studies of social sciences education (Gómez-Trigueros, 2018).

Procedures and Analysis of Data

In relation to the research procedure, the questionnaire was administered in an intermediate session of the first semester (undergraduate and postgraduate), and during the month of November in the case of active teachers (Teacher Training Center course) throughout throughout the designated academic courses and with a response time of 20 minutes. The study was carried out according to the guidelines of the Declaration of Helsinki (Declaration of the World Medical Association), guaranteeing the ethical-philosophical commitment and unwavering respect for human dignity, privacy, physical and moral integrity, as well as the protection of personal data in the processing of the survey and throughout the research. Privacy regulations were complied with, taking into account the personal data protection code (Organic Law 3/2018), anonymity and informed consent. Also, the objectives of the study and its importance in relation to improving the training processes of teachers in training have been reported.

Regarding the data analysis procedure, the SPSS v.28 program has been used to carry out a statistical-inferential analysis (non-parametric tests) of frequencies and percentages. For the analysis of the nominal (non-dichotomous) items (item 1, 26, 27) and the ordinal items (item 4, 28 and 29), the Chi-square analysis ($\chi 2$) was carried out with the objective of detecting linear relationships between these items. As the assumptions of normality and equality of variances were not met, the non-parametric Kruskal-Wallis H test was implemented to check the relationship between ordinal variables (items 28 and 30) and nominal variables (item 1) and the coding of open responses (item 31), generating frequency analysis.

Results

Teacher Training in Flood Risks

Prior to the analysis of the didactic proposals, a descriptive analysis of each of the groups that make up the participating sample has been carried out: a) Degree in Primary Education Teacher; b) Master of Teaching in Secondary Education students; c) active secondary teachers (item 1) and the training received in content on flood risks (items 26 and 27). To do this, a contingency table has been prepared (Table 3).

Table 3

Training received in the contents studied by the participating sample

Participant sample	Training received in natural risks and floods						
	Yes	R%	No	R%	Total	R%	RT%
DTP	219	36.8%	377	63.2%	596	100%	76.0%
MTS	59	45.8%	70	54.2%	129	100%	16.5%
AT	15	25.5%	44	74.5%	59	100%	7.5%
Total	293	37.4%	491	62.6%	784		100%

Note. R%=relative percentage; RT%= total relative percentage.

The results show that the majority of participants have not received training on these topics (62.6%; n= 491). Specifically, active teachers are the participating group that has had the least preparation on flood risks (74.5%; n=44) followed by the primary education degree students (63.2%; n=377). On the opposite side, the Master of Secondary Education students are the ones with the highest relative percentage of affirmative answers regarding their training in this knowledge (45.8%; n=59). It is observed that, in all cases, the number of negative responses (62.6%; n=491) is higher than the number of affirmative responses (37.4%; n=293). These results show the limited presence of these

contents in the training of teachers at the Primary and Secondary Education levels, indicative of the weak importance given to it in the preparation of future teachers.

If the results are studied based on the situation of the participants (item 1), it is found that active teachers are the ones who have received the least training (74.5%; n= 44), followed by the students of the Teacher's Degree/ a of Primary Education (63.2%; n=377). On the opposite side, the students of the Master of Secondary Education stand out for showing a higher percentage of affirmative answers in relation to the training received in these contents (45.8%; n=59) (Table 3).

Perception of Teacher Training

In the particular case of active teaching staff and Postgraduate students, a descriptive analysis has been carried out through cross tables, as well as a correlation study to verify the relationship between the specialty of the studies carried out (Geography, History, Art History or others) (item 4) and training to address these contents in the classroom (item 28). To do this, the Chi-square statistic ($\chi 2$) has been used to determine if there are statistically significant differences between the expected frequency and the observed frequency and, also, to be able to define the type of relationship between variables studied (low-medium-high/ positive-negative) (Reguant et al., 2018).

The Chi-square statistical results are significant (p=0.000), confirming the relationship between the studies carried out and the greater or lesser perception in relation to the training to teach these contents in the classroom (Table 4).

In this sense, the data show a negative perception towards training in this knowledge by the participants who graduated in History (n=106) with greater response options on the proposed Likert scale 1=Strongly disagree (n=24) and 2=Disagree (n= 67) and the absence of a response in options 4=Agree and 5=Totally agree. Something similar occurs with participants with training in Art History (n=42) and in other degrees other than those mentioned (n=11), with a greater number of responses from these same options 1=Strongly disagree and 2=In disagreement and the non-presence of responses for options 4=Agree and 5=Totally agree. On the opposite side are the participants with studies in Geography (n=29) who present a greater number of responses in the options 4=Agree (4) and 5=Totally agree (20) and the absence of responses in the options 1=Strongly disagree, 2=Disagree and 3=Neither agree nor disagree (Table 4).

Table 4

Training to teach floods according to previous disciplinary training

Previous disciplinary	Training to address content in the classroom							
training	1	2	3	4	5	Total	$\chi 2$	p
Geography	0	0	0	9	20	29		
History	24	67	15	0	0	106		
History of Art	2	24	16	0	0	42	208.498	0.000
Others	3	8	0	0	0	11		
Total	29	99	31	9	20	188		

Note. 1=Strongly disagree; 2= Disagree; 3=Neither agree nor disagree; 4=Agree; 5=Totally agree; $\chi 2$=Chi-square; p=asymptotic significance (two-sided).

These results related to the values obtained with Chi-square reveal the positive relationship between the preparation and development of previous studies in Geography with the positive or very positive perception towards training in content related to floods and natural disasters; empowering those who have this training to teach such topics in the classroom.

With the intention of knowing the significance in the specific existing relationship according to the studies carried out, and the perception of the participating sample regarding their training for the treatment of the indicated contents, the non-parametric Kruskal-Wallis H statistic has been found (H) for independent samples. The values obtained are significant (H=97.047; p=.000) and confirm the

existence of differences in relation to the previous training of the participants. Specifically, in the post hoc tests of H, the contrast test is observed by studies carried out and in pairs (Geography, History, History of Art, Others) (Table 5).

Table 5

Pairwise comparisons of previous studies conducted and perceived training

	ep	*de*	*dep*	*p*
Other studies-History	12.162	15.841	.768	1.000
Other studies-History Art	39.169	16.937	2.313	.124
Other studies-Geography	112.455	17.708	6.351	.000
History-History Art	-27.007	9.118	-2.962	.078
Geographic-History	100.292	10.480	9.570	.000
History Art-Geography	73.286	12.073	6.070	.000

Each row tests the null hypothesis that the distributions of Sample 1 and Sample 2 are equal. The asymptotic significances (two-sided tests) are displayed. The significance level is 0.05.

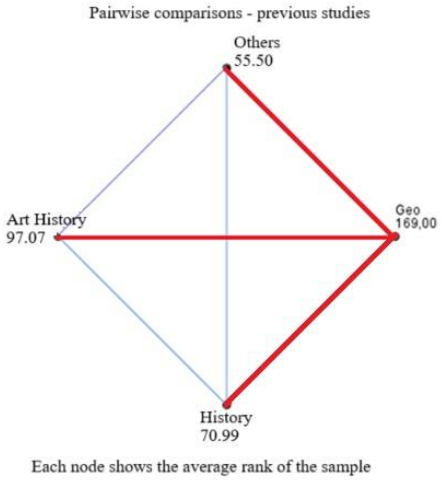
Note. ep= Test statistic*; de*=deviation error*; dep*=statistical deviation of the test*; p*=significance.

The results reveal significant contrasts between the sample with previous studies in Geography and those who have studied Art History (*ep*=73.286; p=.000); graduates and/or graduates in History (*ep*=100.292; *p*=.000); and those who have carried out studies other than those mentioned (*ep*=112.455; *p*=.000). The rest of the comparisons do not show significance, exceeding the value of *p*≤0.05 in the test carried out (Table 5).

To visually confirm these comparisons and know which results are the most favourable, the 2x2 comparison rank graph is added (Figure 1) where four nodes are observed, representing each of the four categories of previous studies (item 1).

Figure 1

Graph of average contrasts by comparison between pairs-previous studies



In red are those contrasts that have been significant in the relationship in pairs (Geography with the rest of the previous studies) and, in blue, the absence of significance of the contrasts (the rest of the previous studies with each other). In relation to the results obtained, the highest average contrast value stands out in the participants who have studied Geography (v=169.00) followed by

those from Art History (v=97.07), History (v=70.99) and other studies other than those mentioned (v=55.50).

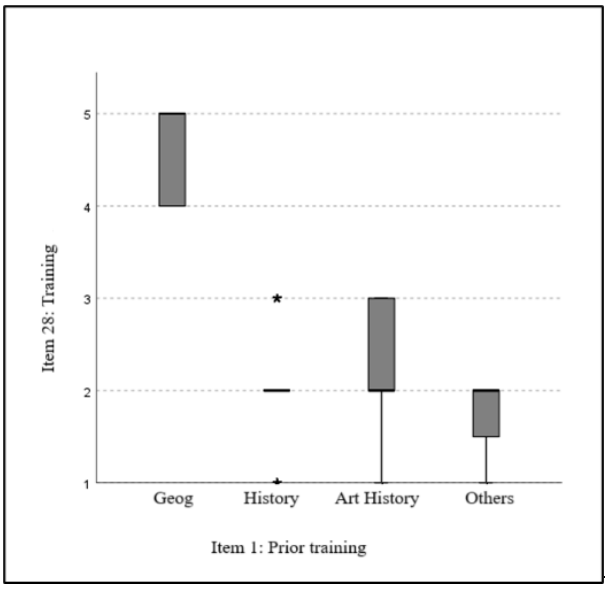
Also, the box diagram of the responses issued by the sample has been found (Figure 2) where it is observed that the self-perception related to the training to address these topics in the classroom has a higher median among the participants who have studied Geography. In addition, it presents a distribution with ratings related to the option 4=Agree and 5=Totally agree on the Likert scale created.

The rest of previous studies such as History and Art History show a lower median, close to option 2=Disagree on the Likert scale, with greater dispersion in the responses towards option 1=Strongly disagree and 3=Do not agree, nor disagree.

As for those from other studies, the median is located between values 1 and 2 of the Likert scale.

Figure 2

Self-perception box plots of the sample by studies carried out



Qualitative Analyses for the Categorisation of the Proposed Classroom Strategies

Another of the issues analysed has been the type of didactic proposals and classroom strategies selected by the sample for teaching these contents in class. As it is an open response item, it has been coded after identifying the content patterns and the available information has been categorized. For this, the keywords were counted; the frequency (*f*) of the most recurrent responses in item 31 and the percentages of the textual fragments of the concomitant items (*R%*) were recorded. The MAXQDA software (v.2020) was used for the analysis, due to its capacity for coding, categorization and information saturation. This qualitative study yields results that converge with those obtained in the quantitative analysis of the questionnaire used, previously indicated.

The data obtained that are collected among the responses given show three basic types of didactic proposals and actions in the classroom: a) those that have to do with the direct and experiential contact of the phenomena and contents to be worked on; b) technological resources, indirectly related to the topics of the study; c) specific thematic exhibitions with expert personnel, external to educational centres. Based on the responses issued by the sample, they have been organised and categorised as shown in Table 6:

Table 6

Terms for the definition of the dimensions analysed in the responses to item 31

Category	Concept	*f*	%	*R%*
C1. Experiential and direct strategies	Visits to affected places through routes and exits	240	30.6	41.4
	Analysis of upcoming dangers and proposals for action	73	9.3	
	Participation in dialogues, interviews in affected environments	12	1.5	
C2. Indirect and technology-mediated strategies	Viewing scientific videos and documentaries	112	14.2	46.7
	3D viewers and programs like PATRICOVA, Google Earth, Argis and others	101	12.8	
	Text book	69	8.8	
	Master class, expository	82	10.4	
C3. Dialogue strategies and resources with experts	Expert talks	43	5.4	11.9
	Participation in conferences and conferences	14	1.7	
	Visit to the expert school centre	*38*	*4.8*	

Note. f: frequency*; R%:* Percent representation.

In view of the data, a greater frequency (*f*) of responses is observed in category C2 Indirect and technology-mediated strategies (46.7%). Specifically, the sample indicates as one of the teaching strategies with the greatest presence in their responses the viewing of scientific videos and documentaries (*f*=112; 14.2%), followed by 3D viewers and programs such as PATRICOVA, Google Earth, Argis and others (*f*=101; 12.8%) and the master class, expository (*f*=82; 10.4%).

These didactic proposals for the classroom suggested by teachers in training and in service highlight the perceived importance of digital resources for working on content on floods and flooding. The participants mention the video resource and the documentary as very useful tools to bring students closer to the indicated contents; in addition to ensuring correct information for pupils as they are scientifically based materials, supported by experts in most cases. On the other hand, they also illustrate the negative perception and even a certain distrust of teachers in training and in practice, by suggesting the use of these materials as support for the development of this knowledge.

Also, it stands out that some programmes related to Geographic Information and Communication Technologies (GIT), with open and free access, have been cited, indicating that they know the didactic potential of these tools and the importance of training in digital skills.

Category C1 Experiential and direct strategies obtain the second highest weighting of the responses indicated by the sample (41.4%) with special intensity the option visits to affected places through routes and exits with the highest total frequency of responses (*f*=240; 30.6%), followed by the implementation of analysis of upcoming dangers and proposals for action (*f*=73; 9.3%). This group of proposals links directly to the importance of direct contact of students with the knowledge they must acquire. In this sense, it is important to highlight the notion "routes and exits" as a key teaching resource in the educational process of the environment and the consequences derived from climate change such as floods.

Finally, category C3 corresponding to dialogue strategies and resources with experts represents 11.9% of the strategies proposed by the sample. Among the selected options are talks by experts (*f*=43; 5.4%), as well as visits to the school by experts (*f*=38; 4.8%). Although this block of didactic proposals is the one with the least presence, it is important to highlight that the resource "experts" reappears in the imagination of teachers in training and in active service as key resources in the development of these contents. Again, this type of response is related to negative self-perception in the preparation of Social Sciences teachers to achieve student learning about this knowledge.

Discussion

The current context of serious environmental situations such as floods, widespread in the Mediterranean area, requires the preparation and training of citizens in the face of such catastrophes. The governments of the world are aware of this need with the flight forward of active citizens in the face of the consequences derived from climate change. Thus, the incorporation of new spaces for participation, although it has generated a movement for change, has to overcome hurdles such as the lack of scientific information among citizens or the treatment of the issue from a pessimistic vision, which promotes, in many cases, inaction as the only solution to these problems (Poma, 2020).

To achieve this, it is essential to train teachers in content related to climate change and natural disasters as one of the keys, priority objectives in the training of Social Science teachers (Sánchez-Almodóvar et al., 2023). It is, through school and education, the most appropriate option to achieve complex, critical and conscious learning about how to deal with the problem of climate change and, also, how to act in dangerous situations that arise as a result of said change. The challenge of education for the planet would be to forge environmental knowledge and culture in global citizenship, which goes beyond the classroom, seeking empowerment for environmental justice (Canaza, 2019).

In this research, the teachers' perception of these contents and their didactic training to work on them in the classroom have been analysed. From the data obtained, the weak training in this knowledge is verified (OB1) and the negative self-perception regarding the training of teachers in training and active Social Sciences teachers for their didactic development in the classroom (OB2). Through the responses of the sample, a poor preparation of teachers in training (degree in primary education and Master of Secondary Education) is confirmed, as well as active teachers of Social Sciences to fully address the climate change and the specific consequences such as the risk of flooding with the exception of teachers who graduated in Geography. These last participants in the research, as has been proven, do show a positive perception about their knowledge and abilities to implement the work of these contents.

The results confirm that training and active teachers lack the training throughout their preparation as teachers to teach content related to floods, with the exception of those who come from the geography specialty. This circumstance is associated with a precarious preparation of primary and secondary education students to, on the one hand, become aware of the problems associated with climate change and respond actively, based on the scientific knowledge that educational training in school can provide; however, with this lack of preparation of teachers, the ability of citizens to respond to natural risks that particularly affect the population, such as floods in the Mediterranean region, is reduced.

This situation coincides with the results of other previous studies on the social representations of teachers in training in relation to floods (Morote et al., 2021), which indicate that less than a third of primary and secondary teachers received training on these topics. In the particular case of primary education training teachers, have verified that this group has little prior knowledge in relation to flood risks, as well as a reduced perception of the importance of the vulnerability factor to mitigate its impact.

It is evident, therefore, that this is a topic that is scarcely covered in teacher training and, therefore, a pending task that, as Huang et al., indicate (2022), it is necessary to improve the socio-territorial resilience of the changes already manifested by global warming.

It is, from education, due to its role in raising awareness and resilience of students, that action can be taken to educate citizens and, in this way, reduce the risk of human and material disasters in the face of these crises (Azmi et al., 2020). In this sense, previous studies in other regions of the world affected by natural risks show that one of the ways to increase territorial resilience is to provide knowledge about disasters and mitigation techniques (Putra et al., 2022). Through teacher training, social vulnerability to natural disasters can be reduced (Wang & Tsai, 2022). To do this, as has been

pointed out, the requirement for responsible participation is to have the information-training necessary for correct decision-making.

Another of the issues analysed in this research has been to know the characteristics of the teaching strategies perceived as appropriate for the work of content on floods by active and in-training teachers (OB3). Roughly speaking, differences are observed between the proposals of each of the participating groups, linked to the training received. Thus, primary education students consider the use of indirect strategies, mediated by technologies, as relevant; software related to geographic information, geo-sensing and the like; and indirect spatial visualisation through videos or documentaries. This issue can be linked to the training that this group receives in the faculties of Education where they are taught subjects related to technologies for their application in the classrooms. The difficulty lies in the fact that this preparation is usually superficial, with information about computer programmes, their characteristics and their general possibilities without influencing their applicability from didactics (Gómez-Trigueros, 2023), generating dissociation between the manipulative use of the software and the didactic. In recent years, these difficulties have been compounded by Artificial Intelligence (De-Lázaro, 2024) and its inclusion in the teaching of geographic content.

For their part, the students of the Master of Secondary Education focus more on direct, experiential proposals, through the strategy of field trips to spaces affected by this type of phenomena, emphasizing the need to train in action. For this reason, this group points out the analysis of real situations and the creation of responses as key. These results coincide with those of other works that highlight the importance of preparing an active, participatory citizenry that assumes its involvement in decision-making (Canaza, 2019; Gómez et al., 2021).

It should be noted that it is in this group of the sample where the students with training in Geography are found, who are the ones who express the best self-perception of their theoretical and conceptual knowledge related to climate change and flood risk. This positive perception affects the selection of more active and direct didactic proposals, possibly related to ample theoretical preparation, which allows them to delve into more dynamic and less theoretical actions. Works such as those of Moreno-Guerrero et al. (2021) have verified that teachers in training at higher levels opt for more open proposals, framed in large globalized projects, linked to active teaching methodologies, as well as cooperative work, such as case studies or field trips field.

In the group of active teachers, the selection of strategies for the classroom is linked to the resource of talks by experts on climate change and natural disasters. This circumstance highlights key aspects such as the lack of teacher training in this knowledge, which constitutes part of the curricular content of the study plans of educational levels prior to the university level; the little importance given to the correct preparation of teachers on these topics; and the need to carry out an update, in continuous training, of active Social Science teachers (Morote & Olcina, 2023; Yáñez & Gómez-Trigueros, 2022).

These results respond to the second hypothesis of the work, confirming that the majority of teachers tend to use classic visual resources to work on content related to floods and natural risks compared to other more dynamic proposals, with active and significant methodologies. The latter usually appear in the imagination of postgraduate students with previous training in Geography and are not manifested as a teaching strategy among the group of future Primary teachers.

These types of eminently active interventions and proposals are being implemented in other regions of the world, which share flood risks, such as the geographical area of Taiwan, where gamified activities have been designed to teach about floods, the recognition of their causes and consequences, as well as different ways of addressing them, among other key aspects, in the formation of citizenship (Tsai et al., 2020). Ultimately, it is about raising awareness and preparing a more resilient society for the effects of climate change compared to traditional approaches, unattractive to students, which have a negative impact on the acquisition of this knowledge (Abied et al., 2020).

Conclusion and Implications

With this work, part of the scientific gap regarding training and teaching about natural risks (specifically floods) in the Spanish area from the Didactics of Geography has been covered. These contents, given their implications in society, and as evidenced by the new Education Law (LOMLOE, 2020), must be taken more into account in the school environment. However, as has been proven here, the majority of teachers in training and in service have not received training on these issues and, at the same time, are not sufficiently trained. Regarding teacher training, a critical spirit should be promoted regarding the interpretation of information and that teachers have more real knowledge about the effects of climate change, proposing activities for the resolution of socio-territorial problems, and local content.

As a limitation of the study, it is worth mentioning, on the one hand, the small number of geographers who participated. This is something structural, due to the shortage of these graduates who are trained as Secondary Education teachers in Spain. And, on the other hand, in relation to active teachers, the activities that they implement in class to teach floods have been analysed. However, to investigate further into the methodologies and resources used, it is established as a challenge for future research to interview said teachers and, likewise, to know what school students really learn.

Based on this research, other lines of research are proposed related to the importance of flood risk as a consequence of climate change in other geographical places bathed by the Mediterranean Sea such as the coastal area of Greece or France. Also, it is proposed to continue deepening the training of teachers on issues related to climate change and the design of dynamic tasks and activities, in the training of citizens.

Teaching climate change and its associated effects is challenging for teachers due to the responsibility of training younger cohorts to understand and adapt to it. To teach natural risks, it is necessary to interpret and know various factors (danger, vulnerability, exposure) that interact in the territory. Only in this way can society be shown its causal complexity and effects and, likewise, provide arguments for individual actions to mitigate and adapt to these phenomena.

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Appendix

Items analyzed from the questionnaire

Block 1 Socio-educational

1. Current occupation:
    a. Primary Teacher Degree Student
    b. Secondary Teacher Master's Student
    c. Active teaching staff
2. Age
    a. From 18 to 24 years
    b. From 25 to 29 years
    c. From 30 to 34 years
    d. From 35 to 40 years
    e. 41 years or older
3. Sex
    a. Women
    b. Men
    c. Others
4. Previous training received
    a. Geography and History or Geography
    b. History
    c. History of art
    d. Other studies

Block 6 Perception of teacher training received related to concepts, training and classroom strategies to work on flood risk in primary and secondary classrooms

26. Have you previously received any training on these contents at the University (during the Degree)?
    a. Yes
    b. No
27. Have you previously received any training on these contents at the University (during the Master of Secondary Education)?
    a. Yes
    b. No
28. Do you feel qualified to teach these contents??
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Okay
    5. Totally agree
29. The reason for my answer in item 28 is:
    1. Very weak previous training and training
    2. Weak training and prior training
    3. Sufficient training and prior training
    4. Complete training and prior training
    5. Very complete training and prior training
30. Is it worth teaching this content??
    1. Strongly disagree
    2. Disagree
    3. Neither agree nor disagree
    4. Okay
    5. Totally agree
31. What activities, resources, information, etc., do you provide (in the case of active teachers) or would you provide to your students to increase their knowledge about flood risk?

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