

Review

Climate Change Education and Preparedness of Future Teachers—A Review: The Case of Greece

Hara Moshou and Hara Drinia * 

Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, Panepistimiopolis, 15784 Athens, Greece

* Correspondence: cntrinia@geol.uoa.gr

Abstract: Climate change is a global issue with implications at many levels. Mitigation and adaptation to its growing impacts are of paramount importance for human livelihoods. Shaping beliefs, attitudes, and values is important in this respect. This shaping takes place mainly during the sensitive childhood years, so the orientation in primary education is particularly targeted. Our overall goal is to lay the foundations for a decent education on climate change that can lead to the desired results. On this basis, the first thing to be considered is the information that will be provided to students by their teachers. The beliefs that are held by primary school teachers in relation to climate change are an important issue for the proper performance of their work. Previous surveys of teachers have had disappointing results. In this paper, an attempt is made to review the research that has been conducted in relation to the knowledge, beliefs, and attitudes of future primary school teachers (either during their studies or during their internship and pre-service training). Emphasis is placed on the case of Greece. Our aim is to highlight the existing research in Greece, by comparing and contrasting data from other countries. Climate change is a very complex issue, and addressing it requires clearly defined actions. Is it possible to achieve the result we need by adding another competence to the already complex role of the teacher? As this review reveals, the little research on the readiness of future teachers suggests that they are not qualified to teach about climate change. It remains to be investigated whether it would be preferable to entrust this responsibility to individuals who have a fuller and more comprehensive understanding and education towards the issue of climate change.

Keywords: climate crisis; awareness; misconceptions; learning; pre-service teachers; Greek; educational system



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1. Introduction

“Climate” is defined as the average of weather conditions in a region over at least thirty years and includes seasonal variations and extreme weather events [1]. Climate change is defined by the United Nations Framework Convention on Climate Change [2] (p. 3) as “a change in climate that is attributed directly or indirectly to human activity, alters the composition of the global atmosphere, and is in addition to the natural climate variability observed over comparable time periods.”

Climate change is an environmental issue of global scale. The climate undergoes natural historical changes over centuries/millennia. However, human intervention in nature has induced significant changes in the way climate has historically changed, causing abrupt and rapid climate changes relative to historical past changes [3]. Climate can, therefore, change due to natural factors—such as volcanic activity, variations in solar activity, changes in the Earth’s orbit, and pressure fluctuations [4], however, these have resulted in minor climate changes [5].

Over the last two hundred years, successive scientific discoveries have led to an increase in human life expectancy and radically changed the human way of life [5]. Humanity has suddenly taken the earth’s natural resources for granted, possibly viewing them as

limitless, despite being dependent on nature for sustenance and being part of the environment. The use and mismanagement of these resources has led not only to ecological depletion, but also to a disruption of the balance of natural ecosystems and biochemical cycles. Anthropogenic interventions have led to a rapid increase in global warming and glaciers' reduction from 1960 to the present [4], with our era being described as the 'Anthropocene', highlighting the excessive human intervention in nature [6]. The average temperature rise since the mid-19th century is estimated at 1.1 °C [7], with temperatures in the northern hemisphere appearing higher than in the last 800 years [4]. It is estimated that if anthropogenic GHG emissions continue rising at the present rate, the temperature is expected to exceed beyond a 1.5–2 °C increase during this century, compared to pre-industrial levels [7]. For the case of Greece, if the greenhouse gas emissions' increasing rate keeps going on with zero mitigating action, the temperature increase could reach 4.3 °C by the end of the 21st century compared to mid-20th century levels [6]. Although numbers may not seem large, a sharp increase of such a magnitude is capable of leading to melting ice, rising ocean water levels, an increase in extreme climatic events, changes in arable land, desertification, etc. [8,9]. Of course, the above is not devoid of economic, individual, and social implications. On this basis, new terms such as "climate mitigation" and "climate psychology" have emerged in recent years.

Given the seriousness of the situation, education on specific environmental issues from an early age is of utmost importance to achieve the formation of an environmental ethos. If we are trying to form values that is, "goals that serve as a guiding principle in our life and standards for judging people, actions, and events" [10] (p. 86), we are mainly oriented towards early childhood and primary education. School, as a place where values can be taught, can lead to the desired moral development of students [11]. As the children are growing older, when they will be able to understand more of the implications of the specific issues in their lives, they will be "building" environmental awareness. Environmental awareness encompasses the knowledge and understanding of environmental risks and possible ways of dealing with them, as well as values, attitudes, and choices between conflicting interests [12]. Understandably, the 'burden' of this education falls mainly on schoolteachers, apart from families. In this research we are oriented towards future primary school teachers, who will be called upon to take the reins of early childhood education.

2. Conceptual Framework—Climate Change Education and Awareness Raising

Since the Tbilisi Declaration of 1977, the importance of changing human behavior as the main objective of environmental education toward a problem-solving direction has become apparent [13].

Climate change is a complex issue of global scale, and given its dimensions, the importance of joint action cannot be ignored. Scientists from various disciplines have thoroughly studied the phenomenon and even designed mitigation strategies, but it does not seem to be enough [14]. Government policies have been implemented on occasion, but they are insufficient [15]. To be able to address and mitigate the phenomenon, the scientific approach must go hand in hand with the pursuit of public information and awareness-raising on the issue [14]. The community needs to be aware in order to be able to commit to mitigation, that is, taking measures to reduce the causes of climate change, and adaptation directions, meaning resilience needs to be achieved in order to deal with the inevitable impacts through anticipation and preventive measures [16] (as cited in [15]).

Education is potentially the most important tool for transforming society in a way that can cope with climate change and its consequences. The ability to measure awareness of climate change issues, as well as the willingness of individuals to act, is essential to being able to evaluate the effectiveness of climate change awareness and adaptation programs [17]. However, it appears that formal knowledge plays an important role in adaptation rather than mitigation [15]. It is a fact that there is a global orientation towards climate change awareness and education programs. The quality of these programs, which aim to channel knowledge, awareness, and willingness to act, should be researched, and the programs

should be developed considering behavioral patterns and their relationship with internal and external factors [17]. Research [18] has shown that short-term interventions can make a positive contribution to enhancing cognitive content.

Knowledge of a problem does not always lead to action, but it is certainly a prerequisite [19]. In studies which mainly focus on the cognitive dimension of climate change, it is evident so far, that an increase in knowledge brings about awareness-raising and an increase in action-taking and thus can lead to behavioral change [15]. Similarly, many studies report the negative impact of a lack of knowledge and awareness on this ardent issue [15]. For example, Hills [20] (as cited in [18]) argued that misconceptions about environmental issues arise from a lack of knowledge. Nunn et al. [21] also signaled knowledge deficits as a barrier to active citizen participation in the decision-making process on climate change-related issues; they are also pointing to the important parameters of economic deprivation and the sociocultural context that exist in certain places, such as developing countries. Moreover, ignorance or very poor understanding of the issue can lead to reliance on unreliable sources [22] (as cited in [23]). It should be noted that one third of American citizens deny that climate change even exists, or that human activity may be causing it [24].

As understandable, climate change education can lead to awareness raising and action-taking, which both can contribute to citizens' behavioral change towards climate change. This behavioral change along with proper government policies can help with respect to climate change mitigation and adaptation (Figure 1).

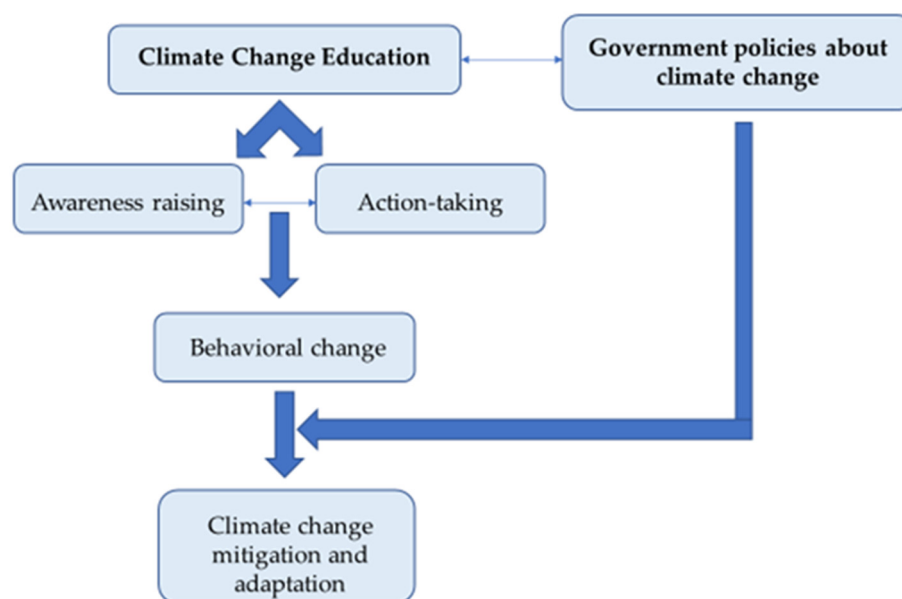


Figure 1. Climate change education as an important part of climate change mitigation and adaptation.

Climate change education has proven to be a particularly difficult task, as there are uncertainties and conflicting views even within the scientific community. Climate change has given rise to a post-normal science ([25–28]) (as cited in [29]), in which significant scientific knowledge coexists with high levels of uncertainty and political pressure [29]. The phenomenon of climate change is a multi-level phenomenon, with social, political, and economic implications that go beyond the boundaries of a pure single-level scientific explanation. However, it is understandable that in order to comprehend the phenomenon, it is inevitable to refer to these implications, but equally important is the contribution of different scientific disciplines.

Recent studies argue that prior cognitive beliefs—cognitive illusions, impede scientific concepts, and phenomena, especially when it comes to intangible phenomena such as climate change. Misconceptions become entrenched [30] and tend to slow the assimilation of new knowledge [31] (as cited in [18]). Several studies have been conducted to investigate

students' and teachers' knowledge. It appears that the existing misconceptions follow a common pattern [32], while some of them become entrenched and persist into later life [33]. Common misconceptions include confusing the evidence between the greenhouse effect and ozone layer depletion, not understanding the greenhouse effect as a natural process, etc. In fact, children tend to consider all pro-environmental behaviors appropriate to address any environmental issue [33].

There appear to be two main fronts to consider. One is today's adult citizens, and the other is today's children—tomorrow's adult citizens. Each of these categories necessitates a distinct course of action. For example, Thaker [34] (as cited in [15]) suggests the use of media in the context of civic education. In the case of students, it is important to direct action toward both current teachers and learners. Furthermore, it has been argued that environmental education and awareness of children can indirectly influence parents [33]. Based on Groves and Pugh [35], when teachers do not properly understand certain issues, they misinterpret them and pass them on in this way to students (Figure 2). Unfortunately, studies on undergraduate university pedagogy students reveal a lack of knowledge about the causes and effects of climate change [36]. It is particularly important to adopt a common understanding of the proper integration of climate change education into academic education globally [37].

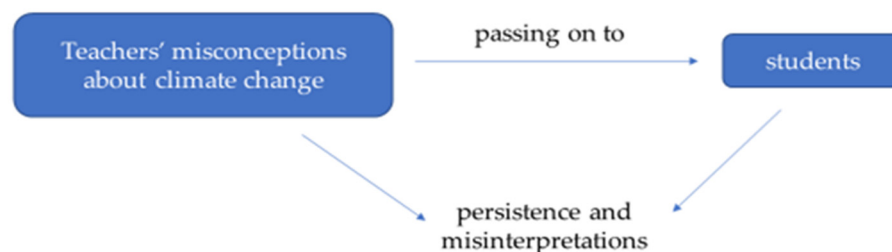


Figure 2. Teachers' misconceptions pass on to students and lead to misconceptions' persistence and misinterpretations.

3. Citizens and Climate Change—State of the Art Research

3.1. Europe

Khatibi et al. [15] conducted a quantitative literature analysis to examine issues of public engagement in relation to climate change and whether public engagement can improve mitigation and adaptation policies. According to the aforementioned research, scientific reports on public knowledge, awareness, and behavior in relation to climate change have increased significantly in recent years, possibly as a result of the devastating effects of climate change since 2012 and the UN World Summit on Sustainable Development in Rio de Janeiro in 2012 [15]. Europe appears to be a leader in this regard, with the UK being the country with the most published case studies. Greece does not appear as one of the 25 reference countries in this review.

According to the APA dictionary, environmental attitudes refer to “the beliefs and values of individuals or societies with respect to nature, ecology, or environmental issues. Research in this area examines how such factors as age, gender, and politics relate to people's environmental attitudes, the influence of environmental education on attitudes, and the role of attitudes in pro-ecological behavior” [38]. In a study that evaluated Europeans' attitudes towards climate change by analyzing polling data from Special Eurobarometer surveys over the last decade [39], it was observed that environmental concern has increased, but not in a linear or homogeneous way. In the year 2019, 58% of EU citizens surveyed considered climate change as one of the four major global challenges, with 77% considering it a very serious problem and 22% ranking it as the biggest challenge. The geographical distribution of attitudes was stable. Environmental concern appears to be highest for northern European countries and lowest for eastern European countries. Based on the survey, northern and southern European countries showed the highest percentage of respondents ranking climate change as a very serious threat. Consistently, the percentages

of respondents ranking climate change as one of the four most important challenges, a threat of at least serious severity, and one of the four most important challenges of at least serious severity were higher for northern, western, and southern European countries than for eastern European countries. Environmental awareness appears to be directly linked to per capita income. The theoretical explanation that is given by Baiardi and Morana [39] is that as income increases, the demand for good environmental quality increases accordingly. This curve was called the “climate change/environmental awareness curve” and is related to the “Kuznets environmental curve” (Figure 3), which describes the inverse relationship between GHG emissions and the level of per capita income. Social trust also seems to play an important role. In addition, a positive relationship was found to exist between media coverage, secondary level education, and climate change concern, but there was a negative relationship with higher education. In addition, an association was observed between climate change concern, personal discomfort due to hot weather, and monetary losses due to damage from extreme weather events. Public concern about climate change, meaning the level at which the public assesses the climate change consequences of its own behavior [40], is negatively influenced by economic insecurity [41] (as cited in [39]).

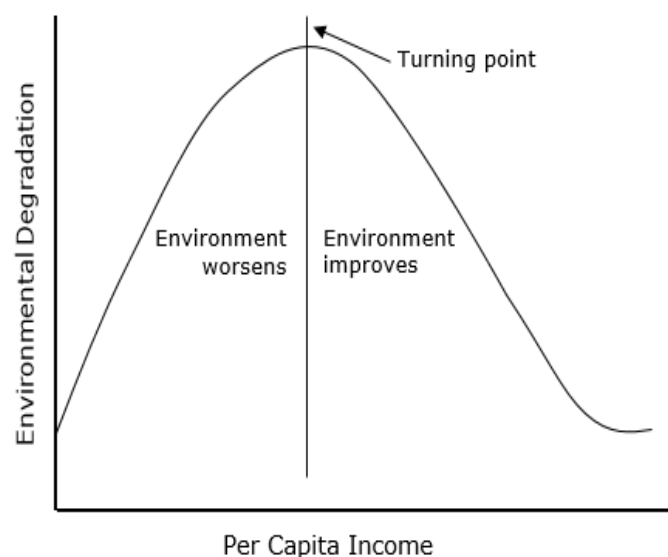


Figure 3. The modified Kuznets curve, which represents the application of the Kuznets curve in environmental studies (source: [42]).

3.2. Greece

According to a survey by the European Investment Bank [43], most Greeks seem to be aware of the importance of climate change, although there are large variations depending on age, gender, and socio-economic status. A total of 83% of Greeks consider climate change to be the greatest challenge for humanity in the 21st century, with 88%—compared to the European average of 77%—considering that climate change affects their daily lives. Furthermore, 76% of survey respondents feel more concerned about this issue than the Greek government, so 62% do not think it is likely that Greece will meet its 2050 carbon emission reduction targets, in line with the Paris Agreement commitment. At the same time, 60% of respondents appear in favor of stricter measures to be taken by the state. As for possible solutions/measures, 95% support education and awareness-raising for children. Based on the survey, 74–68% of low-income people would support the implementation of a tax on products and services that contribute most to global warming. It should be noted that there was also a 9% percentage that believed that climate change and global warming were not caused by human activities.

According to Eurobarometer [44], in 2021, 10% of the Greek population considered climate change to be the most serious global problem (compared to an EU average of 18%);

almost 75% held the government and the European Union responsible, while 33% accepted individual responsibility (Figure 4).

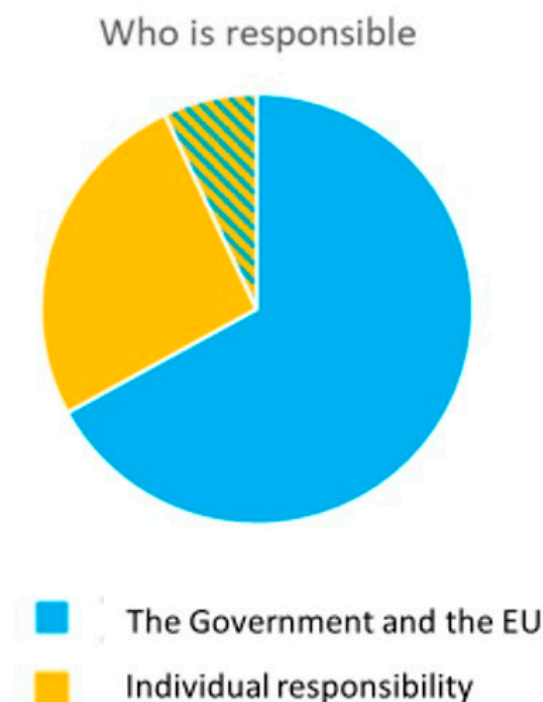


Figure 4. Greeks' opinion about who is responsible for climate change, according to Eurobarometer [44].

In a survey that was conducted on behalf of the Greek Ministry of Climate Crisis and Civil Protection [45] amongst about 2000 Greeks over the age of 17 regarding their attitudes on climate change issues, climate change was considered by Greeks to be the third most important problem on the planet with 13.1%, after natural environment destruction (17%) and regional conflicts or war (13.6%). It is noteworthy that people aged 17–25 consider expensiveness to be the most important problem (18.2%), while in this age category climate change is ranked as the second most important problem (12.3%). A total of 17.8%, Greeks aged 25 to 41 consider price to be the most serious problem on the planet. According to the survey results, approximately 10% of respondents do not believe in the existence of climate change. According to this survey, 53.2% consider governments responsible for addressing climate change, compared to a percentage of 36.5% attributing individual responsibility. Around 90% of people believe that climate change is the result of human activity.

Voskaki and Tsesmenidis' [46] research showed that individuals who belong to the female gender, are younger, have a higher level of education, or live close to Athens are more likely to consider the problem of climate change important, be willing to adapt and change their habits, display pro-environmental behavior, and be willing to pay in order to help mitigate the climate threat. According to the same 2016 survey, the then-existing economic crisis outweighed the climate change issue in terms of importance, with climate change ranking second with 24%. It is worth noting that the older the age and the lower the level of education, the more likely it was for the participants to select the economic crisis or migration as problems of prime concern. The study reveals a higher level of knowledge on climate change mitigation than on adaptation measures. It seems that there is a high level of information (men appear more informed) about climate change and its impact on global warming, while on the other hand, the level of information about Greece's commitments to climate change mitigation is low.

In a survey that was conducted by Skanavis et al. [47] in relation to the assessment of knowledge, attitudes, and behavior of the employees working at the local station of the

Hellenic Electric Company on the island of Skyros towards climate change, it was found that the employees' attitude was for the most part environmentally friendly. However, personal interests and benefits had an influence on personal behavior. Bruun and Olwig [48] (as cited in [15]) identified in their research the anthropocentric knowledge that is available in the community, which may result in individual adaptability but not so easily in a condition of universal resilience and could even exacerbate risk.

The Greek State, adapting to the global requirements for climate change and environmental protection, apparently recognizes the necessity of enriching the present compulsory educational curriculum in this direction. The "Environment and Education for Sustainable Development" curriculum was established in the Greek school system with the recent no. 66152/4 (2820/B/2022) [49] Decision of the Greek Ministry of Education and Religious Affairs for kindergarten, grades 1–6 of primary school, and grades 1, 2, and 3 of secondary school. This decision describes the nature of the "course", but it is subsequently pointed out that it is not a course, as it is not exactly included as a subject in the school curriculum. It is signaled in the aforementioned decision that there is an impregnation of cognitive concepts and value principles relating to the environment in all subjects of the present curriculum. It is a guideline and tool for teachers in primary and secondary education, providing a didactic, step-by-step curriculum cycle for dissemination in the present curriculum of the objectives oriented towards the achievement of sustainable development. Surprisingly, within the decision, there is a mention of the fact that research shows that in the case of environmental education, "the percentage of teachers' involvement in innovative teaching strategies is not satisfactory and, moreover, these actions were not incorporated into the teaching of the subjects" (p. 27924). It goes on to state, "This CP provides teachers with opportunities to use innovative elements in the context of infusion/dissemination in the teaching of the subject areas. What remains is for teachers to understand their necessity in order to adopt and implement them".

4. Preparedness of Future Teachers in Relation to Climate Change Education—Studies' Review

4.1. Greece

In a survey [50] using open-ended questions with Greek prospective primary teachers (first year students at a primary education Greek university department), misconceptions and misinterpretations on issues related to climate change were found. There was misunderstanding about concepts such as weather and climate, as well as a general association of climate change with environmental pollution and phenomena such as acid rain and ozone depletion. In addition, university students did not manage to mention specific measures on how to slow down climate change or mention general measures for environmental protection. Nevertheless, they seemed to recognize the important role of citizens, at both an individual and collective level, in reducing environmental problems and climate change.

A Stylianou and Plakitsi [51] survey of third year (out of four total years) university students of a Greek university department of early childhood education revealed, among other things, that the majority of students had basic general knowledge of the fact that climate change is a situation that affects the entire planet and that the responsibility for reducing the greenhouse effect is a common and collective liability, not just industries' obligation. In addition, over half of the students identified the burning of fossil fuels as the main cause of the problem, but there were points of misconception, such as that burning gas is a mitigating way of dealing with climate change or that there is a link between ozone depletion and climate change. In conclusion, while most university students had some basic knowledge on the topic and/or understood its importance, there did not seem to be a full correlation between theoretical knowledge and the real picture. The need to reduce energy consumption or to be informed and active as citizens were mentioned in theory, but no mention was made of specific ways and tactics. In very specific questions, there were students who did not answer due to a total lack of knowledge, and several misunderstandings were observed in the answers.

Ikonomidis et al. [19] investigated the knowledge of prospective primary school teachers in relation to the causes, impacts, and mitigation actions of anthropogenic global warming and found several misconceptions to exist. In this case, as in others, incorrect associations between the greenhouse effect and the ozone hole were presented—a misconception that is quite common in similar studies of teachers (e.g., [52]). The idea that pro-environmental attitudes help reduce the problem is also a misconception that has been revealed in other studies as well. It is noted that university students were given questionnaires similar to those that were given to secondary school students. However, the differences shown in the results were not remarkable. Ways of reducing the phenomenon seemed to be known, but not by the vast majority.

In a study by Gavrilakis et al. [53] among university students of a Greek pedagogical university department, it was reported that students were aware and informed about environmental issues, but they did not really understand the terms and issues in depth and held misconceptions.

4.2. Other European Countries

Winter et al. [54] conducted a parallel study in Austria with students and pre-service teachers. Both groups reportedly argued that their studies on climate change were superficial and inadequate, and they did not feel prepared to make appropriate decisions and take appropriate measures to ‘change’ the current situation, despite having the will to do so.

In Finland, Tolppanen and Kärkkäinen [55] examined pre-teachers’ views on where they attributed responsibility for climate change mitigation and the appropriate measures to be taken in this direction. Only a small percentage of survey participants approached the issue in a systemic way. Measures were approached rather loosely, without a full understanding of how helpful they were, and an affirmative support appeared to exist for the need for strict state measures.

Research by Tolppanen et al. [36] among pre-service teachers in Finland showed that future educators had a particularly low level of knowledge regarding the effectiveness of actions taken to mitigate climate change, and they appeared to overestimate less effective practices and underestimate highly effective practices (based on the categorization of Wynes and Nicholas [56] as cited in [36] (p. 1630)). High-impact actions based on the categorizations of Häkkinen and Kangas [57] and Wynes and Nicholas [56] (as cited in [36] (p. 1630)) are, for instance, having fewer children per family, living without a car, avoiding air travel, and eating a vegetarian diet. Moderate actions include using hybrid cars, recycling, washing clothes in cold water, and not using a dryer. The low-impact category includes upgrading light bulbs and water conservation.

Jeong et al. [37], after surveying teacher candidates in Spain, found that student awareness increased with the implementation of the active inverse classroom model in a university course, and future teachers appeared more willing to actively engage in climate change education.

Vukelić et al. [58] examined the willingness of Croatian student teachers to take action on mitigation and adaptation in terms of climate change. The study’s findings revealed that believing in the importance of the problem did not increase one’s willingness to take action. On the contrary, a positive attitude, the perception that mitigation and adaptation are possible, and an interest in the issue did.

4.3. Countries Outside Europe

In Turkey, Dal et al. [17] researched the knowledge of social and science teachers who had previously participated in a three-day global warming awareness seminar. The pre-seminar teachers had, as expected from the curriculum they had undertaken, a basic awareness and understanding of climate change. However, their overall knowledge and awareness of the issue were rated as low, although they improved slightly after participating in the seminar program.

In a study by Dal et al. [59], knowledge of Turkish pre-service teachers in relation to climate change was investigated, and as expected, based on the curriculum guides, it was high. They then investigated whether this increased awareness about climate change led to changes in willingness to act on climate change positive behavior. Based on their self-reports, university students expressed a willingness to act. The research found positive correlations between willingness to act and knowledge of the causes and effects of climate change and awareness of climate change-related initiatives. The research concluded that emphasis should be placed on the curricula of future teachers and the impact these have on their understanding, awareness, and behavior in relation to the major issue of climate change.

Competente's [23] study on first-year and senior pedagogy students at a College of Education in the Philippines—presented as one of the countries most affected by climate change—researching their knowledge and attitudes towards climate change, showed low percentages of these parameters in both cases.

In the USA, a survey by Groves and Pugh [35] of junior and senior university students in education, applied sciences, pharmacy, and liberal arts in relation to their knowledge of global warming revealed a difference between science seniors and education seniors. In all samples, misconceptions that were similar to those of a previous study of secondary school students [60] were revealed.

In Groves and Pugh's [18] survey, even after a short-term intervention, pre-service teachers tended to confuse issues related to ozone layer depletion with climate change. The short-term intervention had obvious positive effects, but the overall level of cognitive awareness remained low.

5. Discussion

The phenomenon of climate change has been of particular concern to the scientific community in recent years due to the multi-level impacts it entails at a global level. The causes and impacts have been clarified, and scientific guidelines for mitigation and adaptation have been proposed. Public participation is essential, as only a collective effort can achieve a universal result.

When referring to citizens, there are initially two categories: today's adult citizens and today's children, who are tomorrow's adult citizens. As far as adult citizens are concerned, barometer surveys are carried out from time to time, revealing citizens' knowledge and attitudes toward climate change. In addition, there are a few studies on specialized audiences to study conflicting interests (environmental—personal), such as, for example, the study on workers in a lignite power plant [46]. There are also a number of studies on students of all school levels to investigate similar knowledge and attitudes (e.g., [32,60,61]), which reveal misunderstandings and misconceptions [35]. Similar studies are targeted on teachers, whose results were far from encouraging [36] (p. 163). The studies often focus exclusively on the greenhouse effect rather than on climate change as a whole.

In the literature, there is reference to the use of mass education and awareness-raising strategies for the public through mass media and networking. Furthermore, Ikonomidis et al. [19] suggested the existence of an interdisciplinary environmental course in university institutions, while Lester et al. [62] pointed out that it is important to promote cognitive awareness and social activism in parallel and complementary ways. Developing awareness is critical for shaping responsible behaviors in both daily and professional life. Indeed, many professions are called upon to make important decisions in which the environmental dimension is essential.

With regards to students, who are the future social capital, particular attention should be paid to preparing them to cope with and adapt to the impacts of climate change. Lester et al. [62] pointed out as an outcome of their research that students who had a good knowledge background in relation to climate change tended to be activists, and the desire to act increased when cognitive awareness was enhanced. The textbooks that are available in the Greek compulsory education context refer to the topic in a rudimentary way [19],

while concepts and scientific data are scattered in different textbooks and not coherently presented [32]. A recent Ministry of Education and Religious Affairs decision [49] established a theoretical framework for the integration of the environmental curriculum, not as a separate subject but as an interspersed part of the existing curriculum. While this is seemingly correct, on the other hand, there is no proper teacher training in this direction; only guidelines exist. Meanwhile, it ‘throws the ball’ to teachers to implement it, but does not, at least for the time being, provide for a change of textbooks, relevant training, etc.

Teachers are mainly responsible for providing students with the right information and raising awareness on this issue. Emphasis is placed on the pre-service teachers and students of pedagogical university faculties, who will take the lead in this task. Specifically for the Greek context, the curricula of Greek university departments for primary education do not include any exclusively environmental courses related to climate change. In some cases, the issue of climate change is included in courses such as “Concepts and Issues of Environment and Sustainability”, although there are university departments where the issue of climate change is not even included in the curriculum analysis, and even environmental education and environmental issues as a whole may be limited to just one course or may not be of compulsory attendance. However, some of these university departments hold laboratories of environmental education, where members of the teaching staff, researchers, and students, whose interests are in line with the subject of the Laboratory, can be occupied. As can be understood, future teachers in Greece are not adequately prepared to be able to undertake the teaching of environmental issues, let alone the crucial issue of climate change. In order to acquire the readiness that is needed, there should either be a radical restructuring of university curricula or the future teachers should attend specialized postgraduate courses or seminars.

Studies highlight the serious shortcomings of prospective teachers and the misconceptions that have become entrenched, which will understandably be passed on to pupils. Cognitive misconceptions become entrenched and are very difficult to change. Boyes and Stanisstreet [33] suggested that education about obscure phenomena, such as climate change, should start early enough because, when someone gets older, it is difficult to overcome cognitive misconceptions, even after targeted interventions. It is of the utmost importance that teachers are properly trained cognitively and behaviorally on the phenomenon of climate change before presenting the given issue in the classroom. Teachers are already charged with a very important educational task, and environmental issues, let alone those that are related to climate change, adding considerable effort and difficulty to their existing work. In addition, it is worth mentioning that environmental education issues tend to be sidelined in the timetable [63], while even in the previously institutionalized flexible zone, many times they were substituted by “basic” subjects.

On this basis, and since the importance of cognitive awareness on climate change issues and its impact on awareness and the desire for action are documented in the literature, it might be appropriate to integrate this issue “decently” as a subject in the curriculum, with parallel diffusion to other subjects, from the very first grades of primary school and to be taught by qualified environmental scientists.

An environmental educator should be capable of interdisciplinary teaching, have the needed background knowledge, keep abreast of developments in the field, and be able to cultivate skills and critical thinking towards problem-solving [64] (as cited in [13]). The main university environmental science programs are characterized by broad interdisciplinarity.

In research studies such as Groves and Pugh’s [35], science students appeared to have more knowledge of issues such as climate change than their counterparts in education, although there are studies that reveal misconceptions among environmental students as well [65]. In any case, from what has been mentioned above, it is speculated that environmental education scientists, who are trained in a multi-level and global way on environmental issues, and who receive pedagogical and teaching competence, are better suited to teach topics of this magnitude. After all, what makes more sense than to have en-

environmental issues taught by environmental scientists, just as music is taught by musicians, theater by theater teachers, IT by IT teachers, and so on.

It is proposed to research the cognitive abilities, attitudes, and willingness to act of prospective teachers (and students of pedagogical university departments) in comparison with those of prospective environmental education teachers (and students of environmental oriented university departments) in order to reveal the presumed difference in suitability.

6. Conclusions

It is very easy for misconceptions to be formed about climate change issues, mainly because they are not taught in a structured and coherent way. Moreover, unfortunately, teachers' misconceptions are being passed on to students and get perpetuated. The aim of this review was to highlight the research of the Greek situation in relation to the incomplete education and understanding of future teachers in relation to climate change. A comparison was also attempted with relevant data that were available for other countries, which showed similar results. For teachers to be able to undertake climate change education seriously and responsibly, they need to strengthen their preparedness for this complex task. A restructuring of the University curricula or specialized seminars for future teachers may be necessary. However, as mentioned, misconceptions are very difficult to change so our main suggestion is that the assignment of environmental issues—especially those related to the complex issue of climate change—teaching, should be entrusted to environmental oriented scientists who are well and comprehensively trained towards the subject. The recommendation should be researched before being implemented.

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