Environmental education: effects on knowledge, attitudes and perceptions, and gender differences

Since it emerged in the 1960s, environmental education has been understood as a response to social concern for the environment (Gough, 2014) and as a decisive tool in the promotion of a responsible citizenry committed to the sustainability of environmental policies (Bell, 2016). In the current context, where the management of climate change has become so urgent, there is a clear need for developing a quality environmental education for the general population, especially among children and young people (Rodrigo-Cano et al., 2019). Thus, environmental education has become a privileged means to attain the goals of sustainable development for both social agents and companies (Ilovan et al., 2019; United Nations, 2019). To reach the social impact that it pursues, environmental education has been especially focused on the child and youth population, since it is not strongly influenced at the social and cultural level (Hueso, 2017). According to Freire (2014), the connection between human beings and nature is built throughout the entire lifespan, although childhood is a crucial moment to enhance such link. This model, focused on the central role of school-age children, does not exclude adults from the processes of environmental education; rather, this poses an education from childhood, where young people would be the promoters of behavioural changes in adults (Cuello, 2003). In fact, some studies have already reported evidence of this indirect impact (Simonds et al., 2019).

Among environmental education programmes, the management of water shortage is one of the main issues, since the demographic growth predicted for the next decades will increase the water demand, which will pose a challenge to governments (Nieto, 2011). The global water crisis, linked to the increasing degree of environmental awareness of society, must become a motivation to raise responsible citizens who are capable of improving the global management of the water resources (Araya & Moyer, 2006). Therefore, there is an increasing need to educate minors to create a culture responsible for the environment and, particularly, the management of water (Cárdenas, 2013; IGU-CGE, 2016). Developing and settling favourable behaviours toward the environment in the first years of schooling increases the probability that these will remain in future stages and multiply their effects on the different sectors of the population pyramid (Thompson et al., 2011). Consequently, water companies have become especially interested in the development of educational programmes to raise awareness among minors (Torres, 2015).

The descriptive studies carried out to date justify the need and the opportunity to promote environmental education through such programmes. Since Varoglu et al. (2018) reported that students usually show wrong

ideas and deficiencies in their knowledge about the environment, as well as inappropriate attitudes and behaviours for adequate protection of the environment. Regarding water, specific knowledge about its management is frequently incorrect among students of all ages (Smakhtin & Schipper, 2008). In this respect, the influence of gender is diverse and inconclusive. Some studies have not found differences between boys and girls (Varoglu et al., 2018), whereas others have reported some differences, in favour of girls (Zhan et al., 2018). Besides, there also seems to be differences between those who live in rural and urban contexts, with those who live in cities being in worse conditions (Grodzińska-Jurczak et al., 2006). However, further research is needed (Warner et al., 2018).

To respond to this reality, intervention programmes specifically related to water have been designed and applied in the last years built from the collaboration between public administrations and different population sectors (Çoban et al., 2011). More specifically, these initiatives have been especially focused on disseminating the understanding of public programmes and reviving the interest of the citizenry in sustainable water resources and water quality (Araya & Moyer, 2006), e.g., through the consolidation of the "World Water Monitoring Day", whose impact has already been reported (Bennett & Heafner, 2004). Other community campaigns have been aimed at generating a better understanding of geology and hydrology (Cockerill, 2010).

Another scope of development of these programmes was the educational scope (Amahmid et al., 2019; Thompson et al., 2011; Zhan et al., 2018), highlighting the propositions that pursue social transformation through behaviour with and in nature (Hueso, 2017). The design of most of these programmes has been based on the existing reality of the immediate environment, considering water conservation as the main objective, and including teachers, and their training, in the design and implementation of the programmes (Genc, 2015). The practical activities that allow transferring the contents learned in the classroom to the family context have proved to be relevant, as well as knowing the previous ideas of the recipients of the programmes (Zhan et al., 2018) and the adult population (Thompson et al., 2011).

Within this model, a wide variety of initiatives have been implemented, including talks, conferences and master lectures (Cockerill, 2010), workshops, and even visits to natural spaces (Cachelin et al., 2009). Other studies have also highlighted the importance of the active role of the recipients of environmental programmes (Genc et al., 2018; Scoarize et al., 2021), with the realisation of direct actions in the specific intervention scope being the most common strategy, such reforestation (Sousa et al., 2016). These field practices have also proved to be relevant in the case of water (Cachelin et al., 2009).

For environmental education to adjust to the needs and allow measuring the impact of educational practices, it is important to determine the recipients' knowledge, attitudes and behaviours, and whether these change as a function of the participation in programmes of environmental education (Simonds et al., 2019). These propositions are found in validated instruments that allow measuring these dimensions, such as the ACSI (Dijkstra & Goedhart, 2012) to evaluate pro-environmental behaviours and knowledge of climate change, the CHEAKS (Leeming et al., 1995) to measure environmental attitudes and knowledge, the Environmental Values Short Form (Zimmermann, 1996) to evaluate environmental values or the Environmental Attitudes Inventory (Milfont & Duckitt, 2010) to measure environmental attitudes. However, there are still few instruments that allow specifically evaluating knowledge, attitudes and behaviours of children and adolescents about water. Besides, there are few studies conducted rigorously with large samples of students, despite the increasing importance of environmental education (Potter, 2010) and the general investment made on it (United Nations, 2019), particularly regarding water (UNESCO World Water Assessment Programme, 2018).

Therefore, there seems to be no clear evidence of the impact of these measures on individual change and social improvement. The relevance of obtaining such information has already been pointed out for years, although, at the same time, the difficulty to attain such goal has also been highlighted, given the diversity of initiatives and environmental education programmes which do not usually produce immediate changes (Amahmid et al., 2019; Benayas et al., 2003). Furthermore, environmental education and programmes related to water are promoted by water companies. This hinders their evaluation since their social objectives include the promotion of respect for the environment and water, but not the difficult task of showing their actions follow the principles of Evidence-Based Practices (Shaw, 2010). Thus, it is fundamental that the companies that lead these initiatives become advanced in the evaluation of the impact of their educational measures on the knowledge, attitudes and beliefs about the environment (Bergman, 2016).

Research Aims and Hypotheses

The present exploratory study aims to advance the need to evaluate the impact of educational programmes that are being developed to address environmental education and, more specifically, water management. This would provide better knowledge of where and how educational efforts should be invested, to ensure the efficacy of the initiatives developed for the protection of the environment and water resources. Therefore, this study analyses the possible changes in the environmental perception, respect for water and

knowledge of the water cycle of primary and secondary education minors, after the implementation of educational programmes.

Based on the reviewed literature, the objectives of this investigation are: 1) To analyse the impact of educational programmes on the environmental perception of minors; 2) To explore the impact of educational programmes about water on the attitudes of respect for water; 3) To analyse the impact of educational programmes about water on the knowledge about the water cycle; 4) To explore the possible differences in the impact of educational programmes according to gender.

Specifically, the related hypotheses are: 1) The development of educational programmes increases the environmental perception of the participants; 2) The development of educational programmes reinforces the participants' attitudes of respect for water; 3) The development of educational programmes increases the participants' knowledge about the water cycle; 4) The impact of educational programmes is similar in boys and girls.

Method

Participants

The study sample was composed of 607 students, between 8 and 16 years of age, from 8 different schools: 6 primary educational centres (hereinafter, PE) and 2 compulsory secondary educational centres (hereinafter, CSE). Specifically, there were 414 PE students (46% girls; M_{age} = 9.94; SD_{age} = .92) and 193 CSE students (44.8% girls; M_{age} = 13.49; SD_{age} = 1.02). Specifically, Table 1 shows the data according to gender, age and stage. Throughout these variables there are some missing data ranging from 31 to 37 (see Table 1).

TABLE 1 ABOUT HERE

Procedure and Design

This study was conducted in collaboration with a Spanish state company of water supply and sanitation that manages the integral cycle of water in a city of Southern Spain and 11 municipalities of the same province. Specifically, it supplies water to 1,064,284 people (Spanish Institute of Statistics, 2018). As a Spanish state company, its duties include the contribution to improving society, in this case, through actions of

environmental sensitisation, whose objectives are: to show citizens how the Water Cycle works, raise awareness about the responsible use of water, thus promoting attitudes focused on the respect for and protection of this resource, and transmitting the environmental initiatives and policies of the company. These contributions are included within a set of educational programmes that are offered to the educational centres.

The interventions offered by the company are organised around two main educational programmes: "Come to meet us" and "Water in the classrooms". The educational centres can choose which specific programmes are necessary for their particular context. On the one hand, the programme "Come to meet us" offers educational centres a visit to different facilities involved in the Integral Water Cycle. This programme includes different facilities for students of different ages, some of them for children over 5 years of age and others for children over 10 years of age. Depending on the facility, the visit takes between 90 and 120 minutes. Furthermore, it includes a campaign of participatory reforestation of the vegetation of a reservoir, whose aim is to disseminate information that contributes to the conservation of ecosystems and the sensitisation of the students. It is aimed at PE students and consists of a first theoretical session that constitutes the basis of a second practical session, in which the reforestation is carried out. On the other hand, the programme "Water in the classrooms" allows students to know the urban integral water cycle, discover and understand the importance of water as a resource, and learn to take care of it. It is aimed at PE students and has a duration of 90-120 minutes. Moreover, it includes a student sensitisation campaign to raise awareness about the ecological problem posed by the wrong use of wet wipes in households, water sanitation networks and the environment. This campaign is aimed at both PE and CSE students, with an approximate duration of one hour. All these educational programmes were implemented by environmental educators and, in all cases, the materials were created by experts and supervised by the company.

Specifically, at the beginning of the academic year 2018-2019, the company contacted educational centres, informing them about the educational programmes that are developed by education professionals trained for the purpose. Among the educational centres that were included for the realisation of the educational programmes, the company randomly selected 8 centres to carry out the investigation. Then, after agreeing with the teachers, the students were given printed questionnaires one week before the implementation of the educational programmes (Time 1; hereinafter T1). To guarantee the fidelization with the programme, a member of the research team randomly visited each environmental education programme and facility. Since there are doubts about the prevalence of the positive effects of environmental education programmes

(Benayas et al., 2003), despite the long-term effects reported by some studies (Williams & Chawla, 2016), at least one month after the end of the interventions in the educational centres, the questionnaires were administered again, following the same procedure (Time 2; hereinafter, T2). All this was carried out during the second trimester of the year 2019.

Measures

Environmental perception. The naturalist orientation, that is, the need of people to get closer to nature, delve into its knowledge and defend it, was measured only in PE students by company choice. To this end, we used the Spanish adaptation of the Children's Environmental Perception Scale (CEPS) (Larson et al., 2011), which explores two differentiated components of environmental perception: eco-affinity and eco-awareness. Eco-affinity is understood as the interest in nature and the predisposition to carry out actions that favour the environment. Eco-awareness refers to the understanding that people show about environmental problems, such as environmental sustainability (Collado & Corraliza, 2015). The scale is unidimensional and consists of 16 Likert items with 5 response options each, from 0 (totally disagree) to 4 (totally agree) (Cronbach's $\alpha = .84$), e.g., "Plants and animals are important to people".

Attitudes of respect for water. Since the attitudes of respect for water are the central axis of the programmes implemented in this study and are a key requirement for the change of behaviour in daily living, it was necessary to apply an instrument that was specifically focused on the respect for water and which was short and easy to administer in PE and CSE students. Therefore, the Water Respect Attitudes Scale (WRAS) was created ad hoc, which is based on validated instruments about environmental attitudes, such as the Children's Environmental Attitude and Knowledge Scale (CHEAKS) (Leeming et al., 1995), the Environmental Values Short Form (Zimmermann, 1996) and the Environmental Attitudes Inventory (Milfont & Duckitt, 2010). This scale consists of 10 Likert items with 5 response options each, from 0 (totally disagree) to 4 (totally agree) (Cronbach's $\alpha = .79$), e.g., "I close the tap of the sink while I brush my teeth to save water".

Knowledge about the water cycle. From the materials of the educational programmes implemented, we built two scales ad hoc to evaluate the knowledge of the participants about the water cycle. On the one hand, we designed the Water Cycle Scale (WCS) for PE, which consists of 14 Likert items, of which 2 are reversed items (items 9 and 10), with 5 response options each, from 0 (totally disagree) to 4 (totally agree) (Cronbach's $\alpha = .65$), e.g., "Water is very important for the life of all living beings". On the other hand, we

developed the Water Cycle Scale (WCS) for CSE, which consists of 20 items, of which 3 are reversed items (items 9, 11 and 16), with 5 response options, from 0 (totally disagree) to 4 (totally agree) (Cronbach's α = .68), e.g., "Water can fall in three different ways, depending on the temperature: hail, rain and snow".

Data Analysis

The analyses were conducted using the statistical software SPSS v.26. Eight variables were created with the mean value of each of the evaluated constructs, in T1 (i.e., before the intervention) and T2 (i.e., one month after the end of the intervention), and basic descriptive analyses were carried out. Paired-samples T-tests were performed to determine the existence of significant differences in the means of each construct and in each item between the different time points (T1 and T2). Cohen's d effect sizes (*d*) were calculated based on the differences of effect sizes between groups.

Results

Previous conceptions about environmental perception, water respect attitudes and knowledge about the water cycle.

The students had an initial mean environmental perception of 3.26. Specifically, the highest scores were on the perceptions about people need plants to live (item 6) and people should take better care of plants and animals (item 10). On the other hand, the lowest scores were on the perceptions about liking to read about plants and animals (item 3) and willingness to help clean up green areas in their neighborhood or nearby (item 14) (see Table 2).

The initial means for water respect attitudes were 3.13 and 2.75 in PE and CSE students, respectively. Specifically, in PE, the highest scores were on the attitudes on closing the tap while brushing teeth (item 3) and not leaving the water running when it is not necessary (item 4). The lowest scores were on the attitudes about getting angry when seeing someone playing with water (item 9) and disliking when seeing people using too much water (item 6). In the case of CSE students, similarly, the highest scores were on the attitudes on closing the tap while brushing teeth (item 3) and not leaving the water running when it is not necessary (item 4). And the lowest scores were on the attitudes about getting angry when seeing someone playing with water (item 9) and reusing water to waste less, had the lowest scores (item 7) (see Table 4).

Lastly, the initial mean knowledge of the water cycle was 2.79 in PE. Specifically, the highest scores were on the knowledge of the importance of water for all living beings (item 1) and size of pipes (item 4). The

lowest scores were on the knowledge of the scarcity of fresh water in Earth for all living beings (item 12) and the fact that after water is used and dirtied, it goes through a purifier, where it is cleaned and returned to the river (item 11). In CSE, the initial mean of knowledge about the water cycle was 2.74. Also, the highest scores were on the in the knowledge of the importance of water for all living beings (item 1) and on the reservoirs on the rivers that store water (item 5). The lowest scores were on the knowledge of the size of pipes (item 9) and the scarcity of fresh water in Earth for all living beings (item 12) (see Tables 6 and 7).

Impact on environmental perception

There were significant differences in the mean environmental perception. The highest scores were on the perceptions about liking to learn about plants and animals (item 1), liking to read about plants and animals (item 3), plants and animals can be easily harmed by people (item 4), our life would change if there were no trees (item 7), liking to spend time in places where there are plants and animals (item 11), and the ease with which nature can be harmed or damaged by people (item 15) (see Table 2).

TABLE 2 ABOUT HERE

According to gender, boys showed significant differences in the mean environmental perception. The highest scores were on the perceptions about liking to learn about plants and animals (item 1), liking to read about plants and animals (item 3), plants and animals can be easily harmed by people (item 4), liking to spend time in places where there are plants and animals (item 11), and the ease with which nature can be harmed or damaged by people (item 15). Girls showed significant differences in the mean environmental perception. The highest scores were on the perceptions about the importance of plants and animals for people (item 2) and our life would change if there were no trees (item 7) (see Table 3: https://doi.org/10.6084/m9.figshare.16553028.v1).

Impact on the attitudes of respect for water

In general, PE students showed significant differences in several responses. Specifically, the highest scores were on the attitudes on disliking when seeing people using a lot of water (item 6) and getting angry when seeing someone playing with water (item 9). CSE students showed significant differences in the mean water

respect attitudes. The highest scores were on the attitudes on willingness to use less water in the shower (item 1), getting angry when seeing someone playing with water (item 9), and willingness to give some money to help protect the environment (item 10) (see Table 4).

TABLE 4 ABOUT HERE

According to gender, for PE boys, the highest scores were on the attitudes on telling family and friends about the information to protect the environment (item 8) and getting angry when seeing someone playing with water (item 9). For PE girls, the highest scores were on the attitudes on willingness to use less water in the shower (item 1) (see Table 5). For CSE boys, the highest scores were on the attitudes on telling family and friends about the information to protect the environment (item 8), getting angry when seeing someone playing with water (item 9), and willingness to give some money to help protect the environment (item 10). The CSE girls showed significant differences in the mean water respect attitudes. The highest scores were on the attitudes on the reuse of water in order to use less of it (item 7) and getting angry when seeing someone playing with water (item 9) (see Table 5: https://doi.org/10.6084/m9.figshare.16553028.v1).

Impact on the knowledge about the water cycle

EP participants showed significant differences in the mean knowledge about the water cycle. The highest scores were on the knowledge of the existence of reservoirs that store water (item 5), the fact that once water is clean and disinfected, it is stored in tanks and pumped (item 7), that it is OK to flush wet wipes, band-aids or chewing gum down the toilet (item 10), after using water and making it dirty, it goes through a water treatment plant, where it is cleaned and returned to the river (item 11), and fresh water is scarce on Earth for all living beings (item 12) (see Table 6).

TABLE 6 ABOUT HERE

CSE participants showed significant differences in the mean knowledge of the water cycle. The highest scores were on the knowledge of the importance of water for life (item 1), the definition of the water cycle (item 3), the use of decanting (item 8), the fact that it is OK to flush wet wipes, plasters or chewing gum in the toilet (item 11), the fact that after water is used and soiled, it goes through a purifier, where it is

cleaned and returned to the river (item 12), the 'roughing' (item 13), the fact that food waste can be flushed down the sink (item 16), and the scarcity of fresh water on Earth for all living beings (item 18) (see Table 7).

TABLE 7 ABOUT HERE

According to gender, PE boys showed significant differences in the mean knowledge about the water cycle. The highest scores were on the knowledge of the importance of water for life (item 1), the existence of reservoirs that store water (item 5), and the recycling of used oil (item 14). PE girls showed significant differences in the mean knowledge about the water cycle. The highest scores were on the knowledge of the importance of water for life (item 1), the fact that once water is clean and disinfected, it is stored in tanks and pumped (item 7), the fact that it is OK to flush wet wipes, plasters or chewing gum in the toilet (item 11), and the fact that after water is used and soiled, it goes through a purifier, where it is cleaned and returned to the river (item 12). For CSE boys, the highest scores were on the knowledge of the importance of water for life (item 1), the fact that it is OK to flush wet wipes, plasters or chewing gum in the toilet (item 11), and the 'roughing' (item 13). The CSE girls showed significant differences in the mean knowledge about the water cycle. The highest scores were on the knowledge of the importance of water cycle (item 2), the definition of the water cycle (item 3), the fact that after water is used and soiled, it goes through a purifier, where it is cleaned and returned to the river (item 12), the separation of organic matter and the drops by shaking, using "turbines", or bubbling (item 15), the scarcity of fresh water on Earth for all living beings (item 18), and the fact that if we don't take care of the water we have now, there won't be enough of it in the future (item 19) (see Table 8: https://doi.org/10.6084/m9.figshare.16553028.v1).

Discussion

The main objective of this study was to determine whether participating in environmental education programmes improved the environmental perception, attitudes and knowledge about water, its management and its conservation, in PE and CSE students. Evaluating the impact of environmental education programmes is essential to identify the areas that can be improved in terms of environmental knowledge, attitudes and sensitivity of students and society in general. Similarly, such evaluation allows improving the design of educational propositions aimed at influencing those dimensions (IGU-CGE, 2016). Lastly, it also

allows determining the change in the environmental attitudes, knowledge and awareness of students and society after the application of environmental education programmes.

Regarding the aspects to improve in environmental attitudes, knowledge and awareness about water, the results show that some of the ideas and attitudes of the surveyed students about water were correct, although they also showed significant deficiencies in all the evaluated areas. More specifically, concerning environmental perception, the responses with the greater agreement were those related to the importance of plants and animals to people. In contrast, the ones that obtained greater disagreement were those related to the desire of knowing more about plants and animals and those that involved spending time, money or personal resources to improve the environment. Regarding the knowledge about water the participants had before the intervention, the items with the highest score were those that stated water is fundamental for the life of living beings and those referred to the water cycle and the states of water. On the other hand, there was a remarkable inaccuracy in the valuation about the availability of freshwater for living beings; such inaccurate valuation does not reflect the limitations that are being reported in some geographical areas, which is probably due to the lack of knowledge about the water purification cycle (Simonds et al., 2019). Lastly, concerning the attitudes of respect for water, the most common ones are those related to saving water when using the tap. However, as previous studies have found (Amahmid et al., 2019), there was remarkably little repudiation toward the unnecessary consumption of water by other people, as well as toward the scarcity of behaviours to reuse water or to use less of it.

The results show a slight decrease in the values of respect for water when comparing the PE and CSE students. Such a decrease in the environmental behaviours along age could be interpreted as a lack of prevalence of the effects of the environmental programmes. In this case, it would be necessary to work on the design of these programmes to obtain more stable and long-lasting environmental behaviours (Freire, 2014; Hueso, 2017). On the other hand, most of the conducts that obtained high scores are associated with curricular contents related to environmental education. Previous studies (Laurie et al., 2016) have highlighted the importance of including environmental contents in the curriculum. This has proved to be the most effective formula to transmit these ideas, although it does not solve the deficiencies observed in some aspects associated with environmental education, in general (Varoglu et al., 2018), and regarding water, in particular, at all ages (Simonds et al., 2019). However, the transformation of these ideas into behaviours targeted to improving the environment seems to be more complex. In this sense, Gough (2014) and Erlandson (2014) pointed out that the contents of environmental education increase awareness, but not

the development of technical competencies that could be applied directly. It is thus clear that raising awareness is necessary to reach social change since it is the last goal pursued by environmental education (Bell, 2016; Hueso, 2017), although new strategies must be implemented for these actions to pose a real change in the behaviour of individuals and society. Along with the generation of environmental knowledge through curricular contents, a greater effort may be necessary to get students to identify and assume the social repercussion of their behaviour, to eventually achieve a true transfer of their learning.

The full implemented intervention improved all the evaluated dimensions and drives us closer to this goal, thus confirming the first three hypotheses of this study. The positive effect of the programme is more evident when the environmental perception and knowledge are evaluated. The responses of the students show an increase in their desire to learn and know more about environmental education, and more specifically about water. Moreover, there was an increase in awareness of how people influence the state of the environment. This change is associated with the development of behaviours of care and respect for our environment, which allows for the transformation of individuals into agents of social change (Bell, 2016; Hueso, 2017). Improvements were also observed in the dimension related to environmental attitudes, although such changes were less significant and mostly associated with CSE students. This may be due to the fact that attitudes are more complex, as they may be conditioned by their prior knowledge and the information they receive from many sources and their daily interaction in society, so they may need longer follow-up (Akompab et al., 2012; Carvalho, 2007). Even though this improvement was small, it must be interpreted with optimism. According to Zareie & Jafari Navimipour (2016), behaviours of environmental care would develop environmental knowledge and vice versa; therefore, these changes could be understood as the seed of solid environmental behaviours. Similarly, the improvement of the personal attitudes of the students eventually impacts their families (Legault & Pelletier, 2000), multiplying the effects of the programme.

The positive effects of the programme may be linked to its design. Previous studies have reported that, in those programmes in which the curricular activities are complemented with experimental educational actions outside of the ordinary classroom, as in the case of the programme “Come to meet us”, there is a greater impact on the results and a greater prevalence of these (Jose et al., 2017; Sousa et al., 2016). Such measures are complemented with classroom sessions in the programme “Water in the classrooms”, which have also shown their efficacy in previous propositions (Laurie et al., 2016).

Regarding the impact of the programme according to the participants' gender, the results show, in general lines, the great similarity between boys and girls. This confirms the last hypothesis proposed in this study, in line with previous investigations (Varoglu et al., 2018).

The results obtained in the present study allow delving further into the effects of environmental education, especially regarding the improvement of environmental knowledge, attitudes and perception about water in PE and CSE students. As a result of participating in the educational programmes evaluated, all the dimensions showed partial, yet significant progress, which reflects the impact associated with this proposition of intervention.

This investigation provides new evidence of the effectiveness of environmental education programmes focused on water. However, certain limitations must be considered. Firstly, Likert scale tests are appropriate, but a combination with semi-structured interviews with students and teachers could provide more information on learning progress. Furthermore, it is necessary to consider that the same questionnaires were administered before and after the programmes, so the possible effect of repeating the same questionnaire twice would need to be taken into account. Also, the evaluated programmes consist of different activities that could not be valued independently. Such evaluation of components would be necessary for future studies to attribute, with greater precision, the change detected in the participants. Likewise, it would have been appropriate to establish a measure to monitor the impact after a longer period since the application of the intervention, to assess the prevalence of the effects. This would favor future lines of research to monitor students' attitudes, which are more complex, and need longer-term monitoring. Lastly, future studies should include a research design with a control group, to obtain a more precise measurement of the impact of the programme.

References

Akompab, D. A., Bi, P., Williams, S., Grant, J., Walker, I. A., & Augoustinos, M. (2012). Awareness of and Attitudes towards Heat Waves within the Context of Climate Change among a Cohort of Residents in Adelaide, Australia. *International Journal of Environmental Research and Public Health 2013, Vol. 10, Pages 1-17*, *10*(1), 1–17. https://doi.org/10.3390/IJERPH10010001

Amahmid, O., El Guamri, Y., Yazidi, M., Razoki, B., Kaid Rassou, K., Rakibi, Y., Knini, G., & El Ouardi, T. (2019). Water education in school curricula: impact on children knowledge, attitudes and behaviours towards water use. *International Research in Geographical and Environmental Education*, *28*(3), 178–193. https://doi.org/10.1080/10382046.2018.1513446

Araya, Y. N., & Moyer, E. H. (2006). Global Public Water Education: The World Water Monitoring Day Experience. *Applied Environmental Education & Communication*, *5*(4), 263–267. https://doi.org/10.1080/15330150601059522

Bell, D. V. J. (2016). Twenty-first century education: Transformative education for sustainability and responsible citizenship. *Journal of Teacher Education for Sustainability*, *18*(1), 48–56. https://doi.org/10.1515/jtes-2016-0004

Benayas, J., Gutiérrez, J., & Hernández, N. (2003). *La investigación en educación ambiental en España*. https://bit.ly/3kELo6r

Bennett, K. R., & Heafner, T. L. (2004). Having a Field Day with Environmental Education. *Applied Environmental Education & Communication*, *3*(2), 89–100. https://doi.org/10.1080/15330150490444232

Bergman, B. G. (2016). Assessing impacts of locally designed environmental education projects on students' environmental attitudes, awareness, and intention to act. *Environmental Education Research*, *22*(4), 480–503. https://doi.org/10.1080/13504622.2014.999225

Cachelin, A., Paisley, K., & Blanchard, A. (2009). Using the significant life experience framework to inform program evaluation: The nature conservancy's wings & water wetlands education program. *Journal of Environmental Education*, *40*(2), 2–14. https://doi.org/10.3200/JOEE.40.2.2-14

Cárdenas, M. F. (2013). La gestión de ecosistemas estratégicos proveedores de agua. El caso de las cuencas que abastecen a Medellín y Bogotá en Colombia. *Gestión y Ambiente*, *16*(1), 109–122.

Carvalho, A. (2007). Ideological cultures and media discourses on scientific knowledge: re-reading news on climate change: *Http://Dx.Doi.Org/10.1177/0963662506066775*, *16*(2), 223–243.

https://doi.org/10.1177/0963662506066775

Çoban, G. Ü., Akpınar, E., Küçükcankurtaran, E., Yıldız, E., & Ergin, Ö. (2011). Elementary school students' water awareness. *International Research in Geographical and Environmental Education*, *20*(1), 65–83. https://doi.org/10.1080/10382046.2011.540103

Cockerill, K. (2010). Communicating How Water Works: Results From a Community Water Education Program. *The Journal of Environmental Education*, *41*(3), 151–164. https://doi.org/10.1080/00958960903295266

Collado, S., & Corraliza, J. A. (2015). Children's Restorative Experiences and Self-Reported Environmental Behaviors. *Environment and Behavior*, *47*(1), 38–56. https://doi.org/10.1177/0013916513492417

Cuello, A. (2003). Problemas ambientales y educación ambiental en la escuela. In Organismo Autónomo Parques Nacionales & Ministerio de Medio Ambiente (Eds.), *Reflexiones sobre educación ambiental II*. Grafo.

Dijkstra, E. M., & Goedhart, M. J. (2012). Development and validation of the ACSI: measuring students' science attitudes, pro-environmental behaviour, climate change attitudes and knowledge. *Environmental Education Research*, *18*(6), 733–749. https://doi.org/10.1080/13504622.2012.662213

Erlandson, B. E. (2014). Improving Learners' Ability to Recognize Emergence with Embedded Assessment in a Virtual Watershed. *Technology, Knowledge and Learning*, *19*, 183–204. https://doi.org/10.1007/s10758-014-9227-3

Freire, P. (2014). *Pedagogy of Hope: Reliving Pedagogy of the Oppressed*. Bloomsbury. https://bit.ly/3f7s6W9

Genc, M. (2015). The project-based learning approach in environmental education. *International Research in Geographical and Environmental Education*, *24*(2), 105–117. https://doi.org/10.1080/10382046.2014.993169

Genc, M., Genc, T., & Rasgele, P. G. (2018). Effects of nature-based environmental education on the attitudes of 7th grade students towards the environment and living organisms and affective tendency. *International Research in Geographical and Environmental Education*, *27*(4), 326–340. https://doi.org/10.1080/10382046.2017.1382211

Gough, A. (2014). The emergence of environmental education research. In R. B. Stevenson, M. Brody, J.

Dillon, & A. E. Wals (Eds.), *International handbook of research on environmental education*. Routledge. https://bit.ly/2K9gXJ2

Grodzińska-Jurczak, M., Stepska, A., Nieszporek, K., & Bryda, G. (2006). Perception of environmental problems among pre-school children in Poland. *International Research in Geographical and Environmental Education*, *15*(1), 62–76. https://doi.org/10.2167/irgee187.0

Hueso, K. (2017). *Somos Naturaleza: Un viaje a nuestra esencia*. Plataforma. https://bit.ly/35DZGQv

IGU-CGE. (2016). *2016 Charter on Geographical Education*. https://www.igu-cge.org/wp-content/uploads/2019/03/IGU_2016_eng_ver25Feb2019.pdf

Ilovan, O.-R., Dulamă, M. E., Xénia, H.-N. K., Boţan, C. N., Horváth, C., Nițoaia, A., Nicula, A.-S., & Rus, G. M. (2019). Environmental Education and Education for Sustainable Development in Romania. Teachers' Perceptions and Recommendations (II). *Romanian Review of Geographical Education*, *8*(2), 21–37. https://doi.org/10.24193/RRGE220192

Instituto Nacional de Estadística. (2018). *Demografía y población*. https://bit.ly/3f5uJIf

Jose, S., Patrick, P. G., & Moseley, C. (2017). Experiential learning theory: the importance of outdoor classrooms in environmental education. *International Journal of Science Education, Part B*, *7*(3), 269–284. https://doi.org/10.1080/21548455.2016.1272144

Larson, L. R., Green, G. T., & Castleberry, S. B. (2011). Construction and Validation of an Instrument to Measure Environmental Orientations in a Diverse Group of Children. *Environment and Behavior*, *43*(1), 72–89. https://doi.org/10.1177/0013916509345212

Laurie, R., Nonoyama-Tarumi, Y., Mckeown, R., & Hopkins, C. (2016). Contributions of Education for Sustainable Development (ESD) to Quality Education: A Synthesis of Research. *Journal of Education for Sustainable Development*, *10*(2), 226–242. https://doi.org/10.1177/0973408216661442

Leeming, F. C., Dwyer, W. O., & Bracken, B. A. (1995). Children's environmental attitude and knowledge scale construction and validation. *Journal of Environmental Education*, *26*(3), 22–31. https://doi.org/10.1080/00958964.1995.9941442

Legault, L., & Pelletier, L. G. (2000). Impact of an environmental education program on students' and parents' attitudes, motivation, and behaviours. *Canadian Journal of Behavioural Science*, *32*(4), 243–250. https://doi.org/10.1037/h0087121

Milfont, T. L., & Duckitt, J. (2010). The environmental attitudes inventory: A valid and reliable measure

to assess the structure of environmental attitudes. *Journal of Environmental Psychology*, *30*(1), 80–94. https://doi.org/10.1016/j.jenvp.2009.09.001

Nieto, N. (2011). La gestión del agua: tensiones globales y latinoamericanas. *Política y Cultura*, 157–176. https://bit.ly/3pMH3SG

Rodrigo-Cano, D., Gutiérrez, J. M., & Ferreras, J. (2019). 35 años de éxitos en la Educación Ambiental en España. *RES: Revista de Educación Social*, *28*, 32–43.

Scoarize, M. M. R., Contieri, B. B., Delanira-Santos, D., Zanco, B. F., & Benedito, E. (2021). An interdisciplinary approach to address aquatic environmental issues with young students from Brazil. *International Research in Geographical and Environmental Education*, 1–15. https://doi.org/10.1080/10382046.2021.1943220

Shaw, B. (2010). Integrating temporally oriented social science models and audience segmentation to influence environmental behaviors. In L. Kahlor & P. Stout (Eds.), *Communicating science: New agendas in communication* (pp. 109–130). Lawrence Erlbaum Associates.

Simonds, V. W., Kim, F. L., LaVeaux, D., Pickett, V., Milakovich, J., & Cummins, J. (2019). Guardians of the Living Water: Using a Health Literacy Framework to Evaluate a Child as Change Agent Intervention. *Health Education and Behavior*, *46*(2), 349–359. https://doi.org/10.1177/1090198118798676

Smakhtin, V. U., & Schipper, E. L. F. (2008). Droughts: The impact of semantics and perceptions. *Water Policy*, *10*(2), 131–143. https://doi.org/10.2166/wp.2008.036

Sousa, E., Quintino, V., Palhas, J., Rodrigues, A. M., & Teixeira, J. (2016). Can Environmental Education Actions Change Public Attitudes? An Example Using the Pond Habitat and Associated Biodiversity. *PLOS ONE*, *11*(5), e0154440. https://doi.org/10.1371/journal.pone.0154440

Thompson, R. "Rudi," Coe, A., Klaver, I., & Dickson, K. (2011). Design and Implementation of a Research-Informed Water Conservation Education Program. *Applied Environmental Education & Communication*, *10*(2), 91–104. https://doi.org/10.1080/1533015X.2011.575728

Torres, M. C. (2015). *Programa de educación ambiental para promover el ahorro de agua y energía eléctrica a nivel domiciliar impartido a escolares en calidad de audiencia intermedia* [Pontificia Universidad Católica del Ecuador (PUCE)]. https://bit.ly/36MCz5N

UNESCO World Water Assessment Programme. (2018). *The United Nations world water development report 2018: nature-based solutions for water*. https://bit.ly/35AFTS1

United Nations. (2019). *The Sustainable Development Goals Report 2019*. https://bit.ly/35D9Dh0

Varoglu, L., Temel, S., & Yilmaz, A. (2018). Knowledge, attitudes and behaviours towards the environmental issues: Case of Northern Cyprus. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(3), 997–1004. https://doi.org/10.12973/ejmste/81153

Warner, L. A., Diaz, J. M., & Chaudhary, A. K. (2018). Informing Urban Landscape Water Conservation Extension Programs using Behavioral Research. *Journal of Agricultural Education*, *59*(2), 32–48. https://doi.org/10.5032/jae.2018.02032

Zareie, B., & Jafari Navimipour, N. (2016). The impact of electronic environmental knowledge on the environmental behaviors of people. *Computers in Human Behavior*, *59*, 1–8. https://doi.org/10.1016/j.chb.2016.01.025

Zhan, Y., He, R., & Wing Mui, W. (2018). Developing elementary school children's water conversation action competence: a case study in China. *International Journal of Early Years Education*, *27*(3), 287–305. https://doi.org/10.1080/09669760.2018.1548346

Zimmermann, L. K. (1996). The development of an environmental values short form. *Journal of Environmental Education*, *28*(1), 32–37. https://doi.org/10.1080/00958964.1996.9942813

Table 1. Characteristics of the sample.

		PE		CSE	
		N	%	N	%
Gender[1]	Girls	174	46.0	86	44.8
	Boys	204	54.0	106	55.2
Age[1]	8	7	1.8		
	9	136	35.9		
	10	139	36.7		
	11	75	19.8		
	12	22	5.8	27	14.1
	13			82	42.9
	14			54	28.3
	15			18	9.4
	16			10	5.2
Stage[2]	Year 4	10	2.6		
	Year 5	213	55.6		
	Year 6	117	30.6		
	Year 7	43	11.2		
	Year 8			69	35.7
	Year 9			92	47.7
	Year 10			32	16.6

Note. [1]In Gender and Age variables there are 37 missing cases.
[2]In Stage variable there are 31 missing cases.

Table 2. Differences between T1 and T2 in the Children's Environmental Perception Scale in PE.

	Items	T1 M (SD)	T2 M (SD)	t	*p*	*d*
	Mean	3.26 (.44)	3.38 (.49)	-4.00	.000	.26
1.	I like learning about plants and animals	3.23 (.79)	3.41 (.78)	-2.97	.004	.23
2.	Plants and animals are important for people.	3.69 (.64)	3.80 (.04)	-1.88	.063	
3.	I like reading about plants and animals.	2.58 (1.06)	2.92 (.96)	-4.01	.000	.34
4.	Plants and animals can be easily damaged or harmed by people.	3.18 (1.18)	3.45 (.99)	-2.71	.008	.25
5.	I'm interested in learning new things to help to protect wild plants and animals.	3.34 (.83)	3.34 (.81)	.086	.932	
6.	People need plants to live.	3.86 (.50)	3.87 (.43)	-.31	.759	
7.	My life would change if there were no trees.	3.45 (1.10)	3.66 (.86)	-2.65	.009	.21
8.	I would be willing to give some of my money to contribute to saving and protecting wild plants and animals.	2.79 (1.02)	2.69 (1.02)	1.10	.273	
9.	I would be willing to spend some of my spare time (after school) in activities to help to solve problems that affect nature.	2.80 (1.01)	2.80 (1.13)	.00	1.00	
10.	People must take better care of plants and animals.	3.78 (.56)	3.77 (.51)	.14	.889	
11.	I like spending time in places where there are plants and animals.	3.22 (.90)	3.43 (.82)	-2.78	.006	.24
12.	I get sad when I see houses built in places where plants and animals used to live.	2.94 (1.02)	2.92 (1.05)	.17	.864	
13.	I like learning about nature.	3.13 (.89)	3.23 (.90)	-1.43	.155	
14.	I would be willing to help to clean green areas (where there is nature) of my neighbourhood or nearby.	2.76 (1.08)	2.88 (1.11)	-1.25	.213	
15.	Nature can be easily damaged or harmed by people.	3.44 (.83)	3.58 (.79)	-2.14	.034	.17
16.	My life would change if there were no plants or animals.	3.63 (.93)	3.69 (.86)	-.89	.377	

Table 4. Differences between T1 and T2 in the Water Respect Attitudes Scale.

Items	PE					CSE				
	T1	T2	t	*p*	*d*	T1	T2	t	*p*	*d*
	M (SD)	M (SD)				M (SD)	M (SD)			
Mean	3.13 (.57)	3.08 (.59)	1.11	.271		2.75 (.58)	2.85 (.64)	-2.10	.039	.16
1. To save water, I would be willing to use less of it when I shower.	3.27 (.88)	3.43 (.92)	-1.59	.115		3.10 (.82)	3.30 (.83)	-2.19	.030	.24
2. To save water, I would be willing to close the tap while I wash my hands.	3.35 (1.02)	3.51 (.91)	-1.69	.094		3.46 (.85)	3.55 (.93)	-.92	.358	
3. I close the tap of the sink while I brush my teeth to save water.	3.69 (.54)	3.66 (.76)	.55	.580		3.70 (.67)	3.66 (.69)	.46	.644	
4. I don't leave the water run when it's not necessary.	3.54 (.85)	3.59 (.88)	-.68	.501		3.59 (.74)	3.50 (.99)	.79	.431	
5. In my daily living, I try to find ways to save water and/or electricity.	2.97 (1.01)	2.95 (1.07)	.15	.882		2.60 (1.02)	2.64 (1.01)	-.34	.737	
6. I don't like it when I see people using a lot of water.	2.71 (1.32)	2.49 (1.31)	2.14	.034	.17	2.58 (1.25)	2.70 (1.15)	-1.08	.282	
7. I reuse water in order to use less of it.	2.77 (1.33)	2.66 (1.35)	1.06	.292		1.84 (1.25)	2.03 (1.15)	-1.40	.165	
8. I would tell my family and friends the information they gave us to protect the environment.	3.50 (.80)	3.39 (.96)	1.18	.239		2.94 (.99)	2.80 (1.18)	1.30	.198	
9. I get angry when I see someone playing with water.	2.40 (1.34)	2.07 (1.48)	2.78	.006	.23	1.45 (1.07)	1.91 (1.16)	-3.66	.000	.41
10. I would give some of my money to help to protect the environment.	2.79 (1.24)	2.59 (1.30)	1.79	.075		2.05 (1.17)	2.35 (1.21)	-3.00	.003	.25

Table 6. Differences between T1 and T2 in the Water Cycle Scale for PE.

Items	T1	T2	t	*p*	*d*
	M (SD)	M (SD)			
Mean	2.79 (.39)	2.95 (.37)	-4.38	.000	.42
1. Water is very important for all living beings.	3.92 (.30)	3.85 (.55)	1.32	.190	
2. The movement of water from some parts of nature to others is called the Water Cycle.	3.45 (.78)	3.45 (.84)	.00	1.00	
3. The heat from the sun makes the water from the sea evaporate, thus forming clouds.	3.53 (.81)	3.54 (.88)	-.17	.865	
4. Water can fall in three different ways, depending on the temperature: hail, rain and snow.	3.68 (.64)	3.74 (.67)	-.83	.408	
5. In rivers, there are reservoirs (built by people), which store water.	2.74 (1.16)	3.12 (1.06)	-3.45	.001	.34
6. The water that is stored in reservoirs is transported to some machines, which clean it so that we can drink it.	3.25 (1.07)	3.40 (.96)	-1.35	.179	
7. Once the water is clean and disinfected, it is stored in tanks and pumped into homes, schools...	3.18 (1.11)	3.43 (.81)	-2.56	.012	.26
8. We have reservoirs in Seville.	3.08 (.95)	2.94 (1.02)	1.18	.239	
9. All pipes are the same size.	1.14 (.92)	1.25 (1.21)	-1.06	.293	
10. It's ok to throw wet wipes, plasters or chewing gum in the toilet.	.25 (.79)	.49 (1.20)	-2.17	.031	.24
11. After using water and making it dirty, it goes through a purifier, where it is cleaned and returned to the river.	2.64 (1.19)	2.93 (1.25)	-2.39	.018	.24
12. There is little fresh water in Earth for all the living beings that inhabit it.	2.10 (1.37)	2.42 (1.22)	-2.55	.012	.25
13. When water is returned to the river, animals and plants can use it.	2.77 (1.14)	2.93 (1.19)	-1.28	.202	
14. Used oil must be kept in a bottle and taken to a recycling centre.	3.10 (1.12)	3.22 (1.06)	-1.06	.292	

Table 7. Differences between T1 and T2 in the Water Cycle Scale for CSE.

Items	T1	T2	t	*p*	*d*
	M (SD)	M (SD)			
Mean	2.74 (.34)	2.92 (.44)	-3.62	.001	.46
1. Water is very important for life.	3.95 (.40)	3.74 (.96)	2.43	.017	.29
2. We have water in Earth thanks to the Water Cycle.	3.33 (.87)	3.50 (1.00)	-1.46	.147	
3. The movement of water from some parts of nature to others is called the Water Cycle.	3.29 (.99)	3.58 (.72)	-2.61	.011	.34
4. The heat from the sun makes the water from the sea evaporate, thus forming clouds.	3.67 (.65)	3.59 (.83)	1.03	.307	
5. Water can fall in three different ways, depending on the temperature: hail, rain and snow.	3.75 (.65)	3.71 (.75)	.61	.544	
6. In rivers, there are reservoirs (built by people), which store water.	3.25 (.85)	3.30 (.90)	-.460	.646	
7. The water that is stored in reservoirs is transported to water treatment plants to make it drinkable.	3.14 (1.04)	3.26 (.88)	-.87	.387	
8. Through decantation, thick and heavy particles are removed, forming mud.	2.58 (1.06)	2.86 (1.00)	-2.17	.032	.27
9. Mud has no use at all.	1.93 (1.05)	1.96 (1.19)	-.20	.844	
10. Once the water is clean and disinfected, it is stored in tanks and pumped into homes, stores, schools...	3.41 (.80)	3.32 (.88)	.877	.382	
11. It's ok to throw wet wipes, plasters or chewing gum in the toilet.	.22 (.69)	.55 (1.13)	-2.74	.007	.35
12. After using water and making it dirty, it goes through a purifier, where it is cleaned and returned to the river.	2.43 (1.26)	2.87 (1.13)	-2.82	.006	.37
13. In purifiers, the large and small particles are separated through "roughing".	2.48 (.85)	2.76 (.89)	-2.58	.011	.32
14. Using a pond called "sand trap-grease remover", most of the sand and grease is removed from the used water.	2.61 (.91)	2.83 (.84)	-1.97	.051	
15. The organic matter is separated from the drops by shaking, using "turbines", or bubbling.	2.58 (.81)	2.79 (.89)	-1.94	.055	
16. The remains of food can be thrown away in the sink.	.56 (.95)	.83 (1.27)	-2.01	.047	.24
17. Used oil must be kept in a bottle and taken to a recycling centre.	3.19 (1.06)	3.24 (1.07)	-.47	.637	
18. There is little fresh water in Earth for all the living beings that inhabit it.	2.66 (1.14)	2.94 (1.15)	-2.15	.034	.25
19. If we don't take care of the water we have now, there won't be enough of it in the future.	3.16 (1.18)	3.21 (1.24)	-.40	.692	
20. When water is returned to the river, animals and plants can use it.	3.06 (.97)	3.11 (1.09)	-.37	.709	