CLIMATOPIA: SELF-DIRECTED LEARNING TO IMPROVE QUALITY OF LIFE

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Abstract

This paper reports on the results of the pilot of the Climatopia project at four schools in Greece. The project was described in a workshop offered by Pyrini and Ioannides at ICICTE 2023, before survey results had been collected and analysed. Results suggest that the Climatopia project had a positive effect on both teachers and students as well as parents and the local community. It encouraged collaboration among students, between students and teachers, between teachers and the community, and among community members. It increased student engagement by incorporating a narrative framework into the content and providing opportunities for students to create their own comics on the theme. In particular, as a result of the project, students at all levels were able to identify that climate change affects not only the environment but also people themselves.

Introduction

Climate change and environmental degradation are an existential threat to Europe and the world. To overcome these challenges, Europe needs a new growth strategy that will transform the Union into a modern, resource-efficient and competitive economy, where there are no net emissions of greenhouse gases by 2050, economic growth is decoupled from resource use, and no person or place is left behind (European Commission [EC], n.d.). Environment and climate action are key priorities for the European Union (EU) now and in the future.

According to the United Nations, "Education is a critical agent in addressing the issue of climate change" (n.d., para. 1). More specifically, the United Nations Educational, Scientific and Cultural Organization (UNESCO) comments "Climate change education helps people understand and address the impacts of the climate crisis, empowering them with the knowledge, skills, values and attitudes needed to act as agents of change" (n.d. a, para. 1). UNESCO promotes climate change education (ECC) as part of its Global Action Programme on Education for Sustainable Development (ESD) (UNESCO, n.d. b). It identifies the cause of climate change

and also suggests a pathway to a solution: “The collective activities of human beings have altered the earth’s ecosystems so that our very survival seems in danger because of changes more difficult to reverse every day. To contain global warming before it reaches catastrophic levels means addressing environmental, social and economic issues in a holistic way (UNESCO, n.d. b, para. 1). Goal number 13 of the ESD’s goals on climate action targets the improvement of education on climate change.

As Maki and Crosier point out for Eurydice (2019), “Education on climate change is grounded in science – but it is also about behaviour and action. It is about the environment and economy, but also about equality and social organisation. It promotes future citizenship that is environmentally and socially responsible on a global scale (para. 7).

The European Union has supported innovative educational efforts to bring awareness of climate change to K-12 students in the hope of slowing or preventing the devastation of our world environment due to irresponsible use of fossil fuels. The Climatopia project is one such effort.

The Climatopia project was funded by the Erasmus+ program of the European Union (Climatopia, n.d.) to develop educational materials and teaching methods to be included in school and teacher training settings and also to be communicated and discussed widely in the communities. The concrete objectives of Climatopia are grounded in UNESCO’s four pillars of lifelong learning (Delors, 1996), which was expanded by the inclusion of a 5th pillar in UNESCO’s Education for Sustainable Development Initiative (2012). With respect to climate change, Climatopia seeks to:

1. Develop the pupils’ scientific knowledge and green skills on climate change using comics and an educational game (Learn to Know);
2. Effectively apply the knowledge acquired in the context of a simulation, decision making game (Learn to Do);
3. Provide ‘designed experiences’ where players can learn through doing and being, rather than absorbing information from readings and traditional lecture formats (Learn to Be);
4. Design highly engaging learning experiences that allow players to build empathy by taking on various roles and perspectives (Learn to Live Together);
5. Envision oneself in the future and seeing consequences of actions at different points in time (Learn to Transform Oneself and Society).

In Greece, as in the other project partner countries, four deliverables were identified in the project design. Result 1, "Climatopia: Theoretical and Psychological

Framework," discusses how both content and learning activities can encourage pupils to actively engage with the subject of climate change and consider possible solutions.

For Results 2 and 3, three novel educational materials about climate change were introduced to four grades in three schools during a two-year period. The materials include:

1. Result 2: Comic Book
2. Result 2: Self-Training Handbook
3. Result 3: Decision-making Game

These materials, which were also utilized by project partners in Austria, Latvia, and Spain, educate pupils through multiple means.

The Comic Book (Result 2) narrates the journey of three school age children on the planet Climatopia as they are guided by "the four elements of the planet": Earth, Air, Water, and Fire. These four beings transport the children to a poor village, a wealthy villa, an old warehouse-turned classroom, and a high-tech school, with clear inequities between the two communities, the two schools, and their approaches to protecting the environment. Next, they all visit a farm owned by the uncle of one of the children, where flooding caused by climate change has damaged crops. The next stop is a return to their own community, where they witness the mayor addressing a skeptical group of climate change deniers who doubt that forest fires can threaten their town. Then, they travel to a meeting of the heads of state of the Union of Middle Continent Countries, where the children grow frustrated as the delegates debate the costs and benefits of engaging in environmentally-conscious policies. Next, they travel into the future to a summit of world leaders, met first by protesters that decry the hunger and lack of drinking water in Climatopia that have resulted from a disregard of sustainable practices. The world leaders also debate "in two opposing camps," one camp arguing for zero carbon dioxide emissions and the other arguing that fossil fuels are needed for economic development. The children recognize that the leaders "blame each other instead of working together." The comic book closes with the children encouraging the reader to recognize the climate change is real but that there are solutions by respecting science and nature and reducing energy needs.

The Self-Training Handbook (Result 2) for teachers included three chapters:

1. Chapter 1: Basic scientific concepts related to climate change (to help prepare the teachers to communicate critical concepts to their students)
2. Chapter 2: Instruction on how to continue the comic (to use comic creation as an interactive tool to further engage students on this subject)
3. Chapter 3: Open Educational Resources for comics creation (to provide free, robust materials for use by students)

The Decision-making Game (Result 3) provides an independent and very interactive means for learners to engage with authentic decision-making with respect to climate change policies that could affect the future of the Climatopia planet. Students can navigate through the game and select different options with respect to climate-related behaviours, which will open up a new set of decisions that can ultimately result in an ideal or a devastated Climatopia. It was designed to be played at multiple levels (basic, medium, advanced). In addition, all students participating in the project were encouraged to created their own comics to continue the story of Climatopia.

Methodology

As the Decision-making Game was completed in the second year of the study, it was implemented only in Year 2. Table 1 summarizes actual implementation of the three types of educational materials across the target schools in Greece over the two years of the project.

Table 1

Implementation of Climatopia Project in Greece: Three Schools

School in Greece	Year	Pupils	Result 1: Comic Book	Result 2: Self-Training Handbook	Result 3: Decision-making Game	N Pre-test	N Post-test
Agia Marina Primary School Nea Makri (Sch-AA)	Year 1 2nd grade	Sch-AA Grp 1	pilot	pilot	n/a	37	
	Year 2 3rd grade	Sch-AA Grp 1	n/a	n/a	pilot		37
Primary School of Kilkis 3rd grade (Sch-3K)	Year 1 3rd grade	Sch-3K Grp 1	pilot	pilot	n/a	12	12
Primary School of Kilkis 6th grade (Sch-6K)	Year 1 5th & 6th grades	Sch-6K Grp 1	pilot	pilot	n/a	21	37
	Year 2 5th & 6th grades	Sch-6K Grp 2	pilot	pilot	pilot	72	68
	Combined Year 1 and Year 2	Sch-6K Grps 1 & 2	pilot	pilot	pilot	93	105
Third Laboratory Center of E. Attica (Vocational Technical School, VET) (EPALRAF)	Year 2 2nd grade of VET (upper secondary)	EPALRAF Grp 1	pilot	pilot	pilot	17	17

Subjects

The pilot teachers were self-trained with the materials produced for Result 1, Result 2.1 (Comic Book), and Result 2.2 (Self-Training Handbook). The materials were piloted with students at three different school levels, as summarized in Table 1 above. Each teacher wrote an individualized report on the administration of the project at their own school.

Pre-test and Post-test

The pilot teachers administered the pre-test to their students, and then introduced the learning materials. They then administered the post-test to their own students.

Results

Results of pre- and post-tests were compiled for each of the schools, including the 3rd and 6th grades in the Primary School of Kilkis, for four sets of data. At the Primary School of Kilkis, the results of two different 6th grade groups are combined. Presentation of results includes an analysis by school, grade, and question, as well as a combined analysis of all schools on several multiple choice questions.

Analysis by School and Grade

Individual students were not identified while taking these tests, and therefore results are reported in the aggregate, in ascending order of grade level. Only some of the results are included here.

Second/third graders (over two years): Agia Marina Primary School

At Agia Marina Primary School, the pre-test was administered to 37 2nd graders, who completed training the next year as 3rd graders and then took the post-test.

Question 1 (multiple choice): What is a greenhouse gas?

Almost 2/3 answered the multiple choice question "What is a greenhouse gas?" (64.86%) correctly during the pre-test by selecting "A gas that traps heat in the earth's atmosphere". All students answered correctly on the post-test.

Question 2 (multiple choice): Is climate change real?

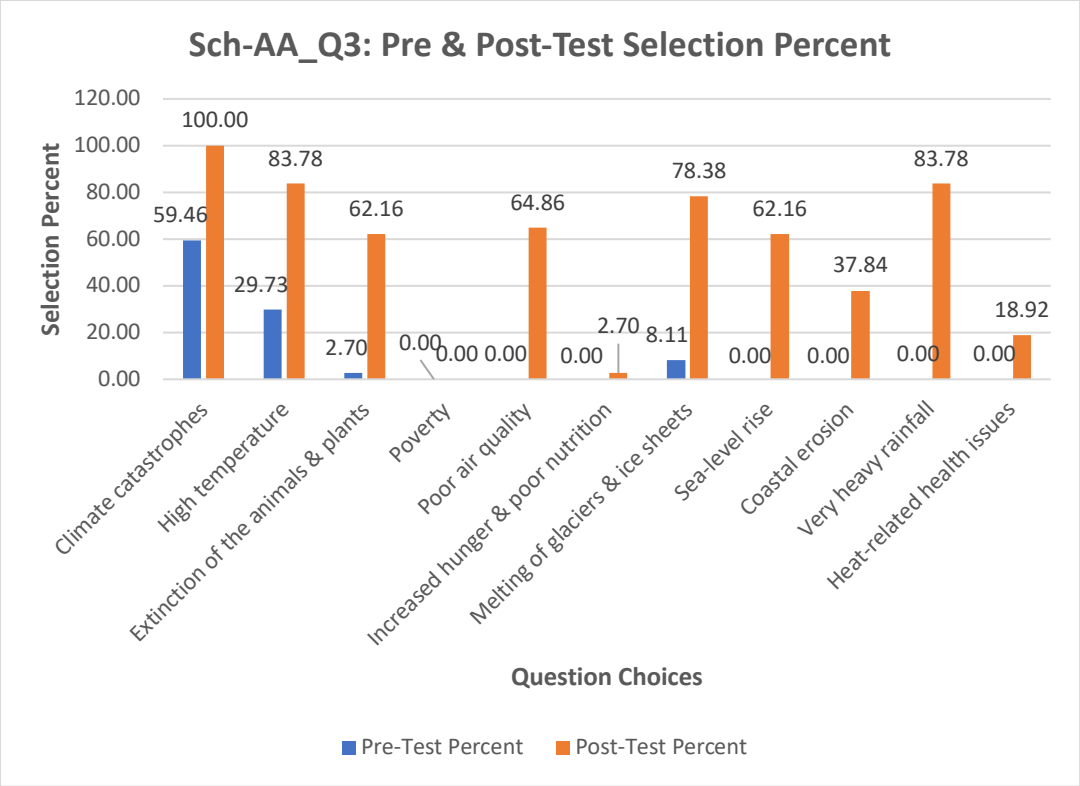
The second question also reveals the effect of the treatment. In the pre-test, just over half of the students (51.35%) believed climate change is real, while in the post-test, 100% believed it. The difference between pre-test and post-test is statistically significant ($X^2 = 23.786$, $p < .001$). This is the only school and grade for which there was a significant difference between pre- and post-tests on this question.

Question 3 (multiple option): What are the negative effects of climate change?

Question 3 allows for 11 answer options for "What are the negative effects of climate change?", all of which are correct. Students selected only four answer options on the pre-test, all of which relate to the environment. In the post-test, ten selections were chosen, including several related to people (Figure 1).

Figure 1

Agia Marina Primary School, 2nd & 3rd graders, "What are the negative effects of climate change?"



Question 4: Open-ended

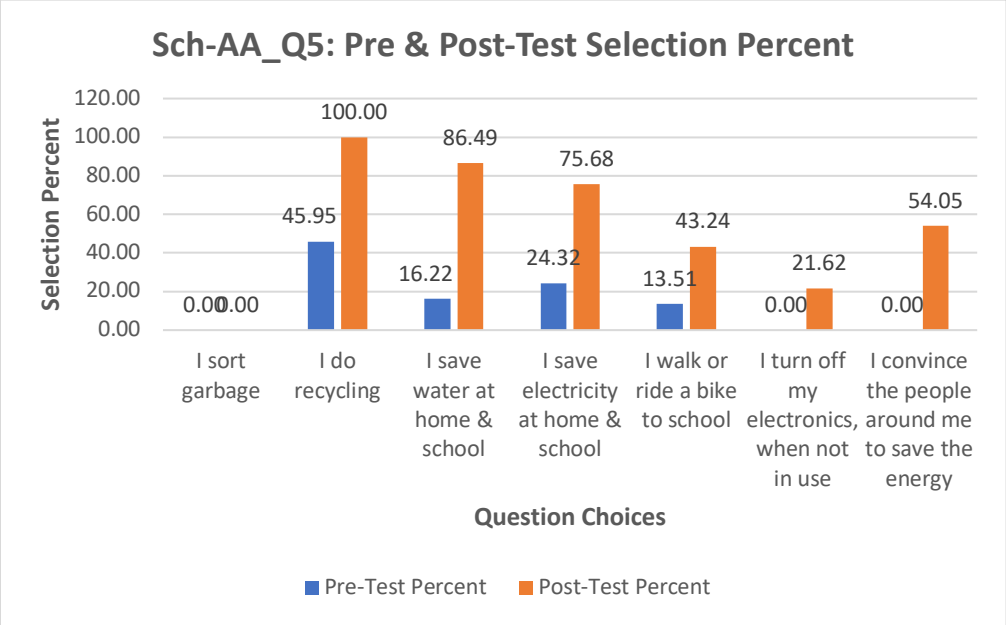
Question 4 was an open-ended question asking students what they believed caused CO2 emissions. At all the schools the results ranged widely—they mention mainly transportation, cooling and heating, and consumption of energy for devices). The results are not further analysed here.

Question 5 (multiple option): What do you do to prevent climate change?

The fifth question involved seven answer options so students could consider what they did personally to combat climate change. Four options were selected in the pre-test, the highest being "I do recycling" at 45.95%. In the post-test, six options were chosen with 100% of the students selecting "I do recycling" (Figure 2).

Figure 2

Agia Marina Primary School, 2nd & 3rd graders, "What do you do to prevent climate change?"



3rd graders: Primary School of Kilkis

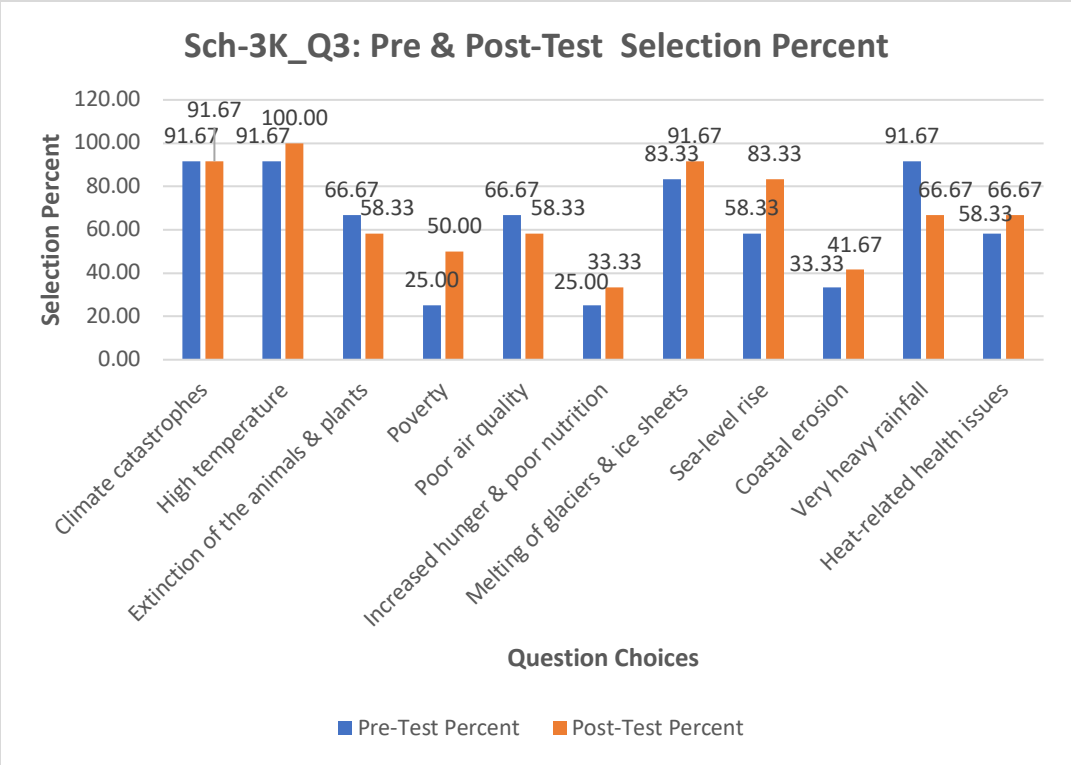
At the Primary School of Kilkis, the pre-test and post-test were administered to 12 3rd graders, all in the same year.

Question 3 (multiple option): What are the negative effects of climate change?

For the question "What are the negative effects of climate change?", all options were chosen on both the pre-test and post-test. However, the percentages differ. The most frequently chosen options on the pre-test were "Climate catastrophes", "High temperature", and "Very heavy rainfall" at 91.67%. The least chosen options on the pre-test related to people: "Poverty" and "Increased hunger and poor nutrition", both at 25%. The options related to people rose to 50% ("Poverty") and 33.33% ("Increased hunger and poor nutrition") on the post-test (Figure 3).

Figure 3

Primary School of Kilkis 3rd graders: "What are the negative effects of climate change?"



6th Graders: Primary School of Kilkis

Two groups of 5th and 6th graders at the Primary School of Kilkis were combined for analysis.

Question 1 (multiple choice): What is a greenhouse gas?

Just over 74% of the 6th graders correctly answered the question "What is a greenhouse gas?" on the pre-test by selecting the answer "A gas that traps heat in the Earth's atmosphere" (74.19%). The percentage of correct responses rose to 96.19% on the post-test, indicating that even these older elementary school students benefited from the training.

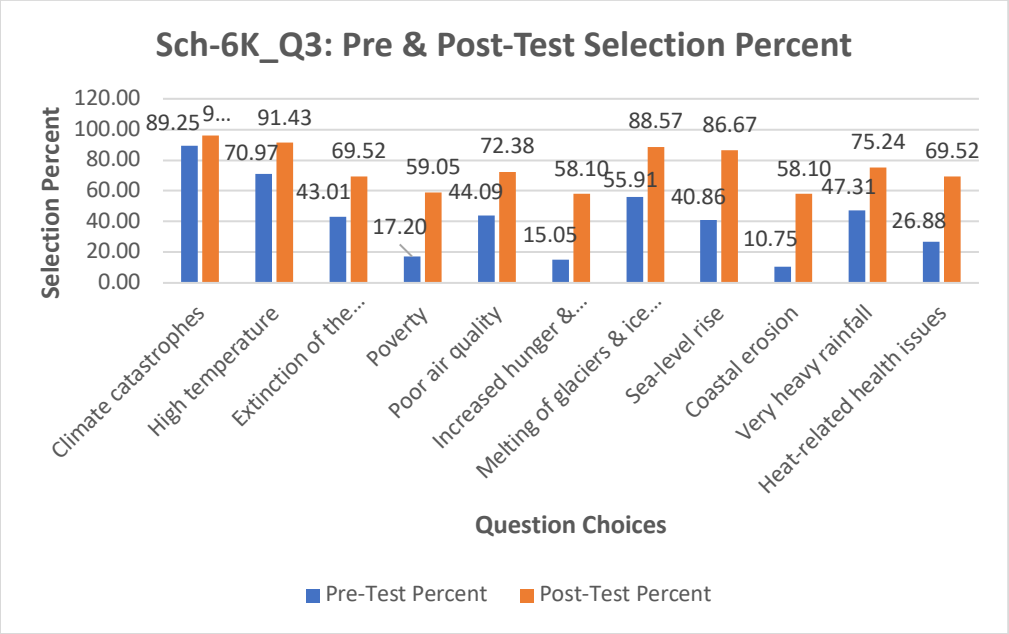
Question 3 (multiple option): What are the negative effects of climate change?

In response to the question "What are the negative effects of climate change?", the 5th and 6th graders selected each option on both the pre- and post-test. The most frequently occurring option on the pre-test was "Climate catastrophes" at 89.25% while the lowest options related to people: Poverty (17.20%) and "Increased hunger

and poor nutrition" (15.05%). On the post-test, the highest options remained the same, but rose. Options relating to people rose greatly, with "Poverty" scoring 59.05% and "Increased hunger and poor nutrition" scoring 58.10% (Figure 4).

Figure 4

Primary School of Kilkis 6th graders: "What are the negative effects of climate change?"

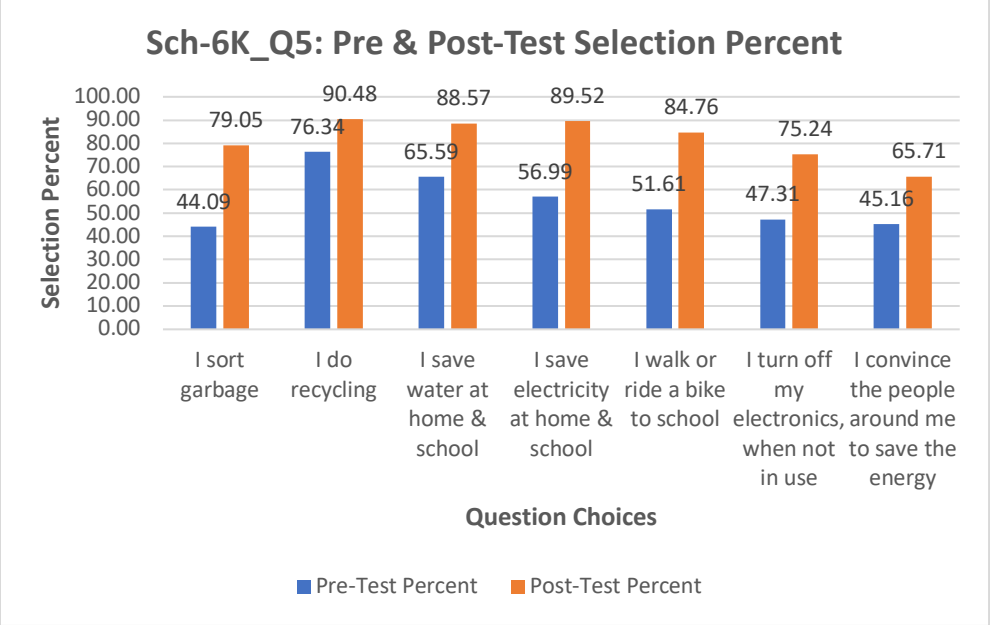


Question 5 (multiple option): What do you do to prevent climate change?

At the time of the pre-test, the 6th graders already seemed to be engaged in helping prevent climate change. They selected every option on the question "What do you do to prevent climate change", with the highest response rate to the option "I do recycling" (76.34%) followed by "I save water at home and school" (65.59%). On the post-test, the frequency of each response rose. The highest response rate was still for "I do recycling", now having risen to 90.48%, while "I save water at home and school" rose to 88.57%. The lowest response was 'I convince the people around me to save the energy", which still rose to 65.71% on the post-test from a pre-test score of 45.16% (see Figure 5).

Figure 5

Primary School of Kilkis 6th graders: "What do you do to prevent climate change?"



Upper Secondary Students: Third Laboratory Center of E. Attica

Seventeen upper secondary students from the Third Laboratory Center of E. Attica completed all activities in year 2 of the program along with their teacher.

Question 1 (multiple choice): What is a greenhouse gas?

Results of the upper secondary students were similar to those of the 6th graders for the question "What is a greenhouse gas?". A large majority (76.47%) were correct on the pre-test, while 94.12% were correct on the post-test.

Question 2 (multiple choice): Is climate change real?

The upper secondary students responded to the question "Is climate change real?" identically in both pre- and post-test; each time all selected the answer "Yes, climate change is taking place according to scientific findings".

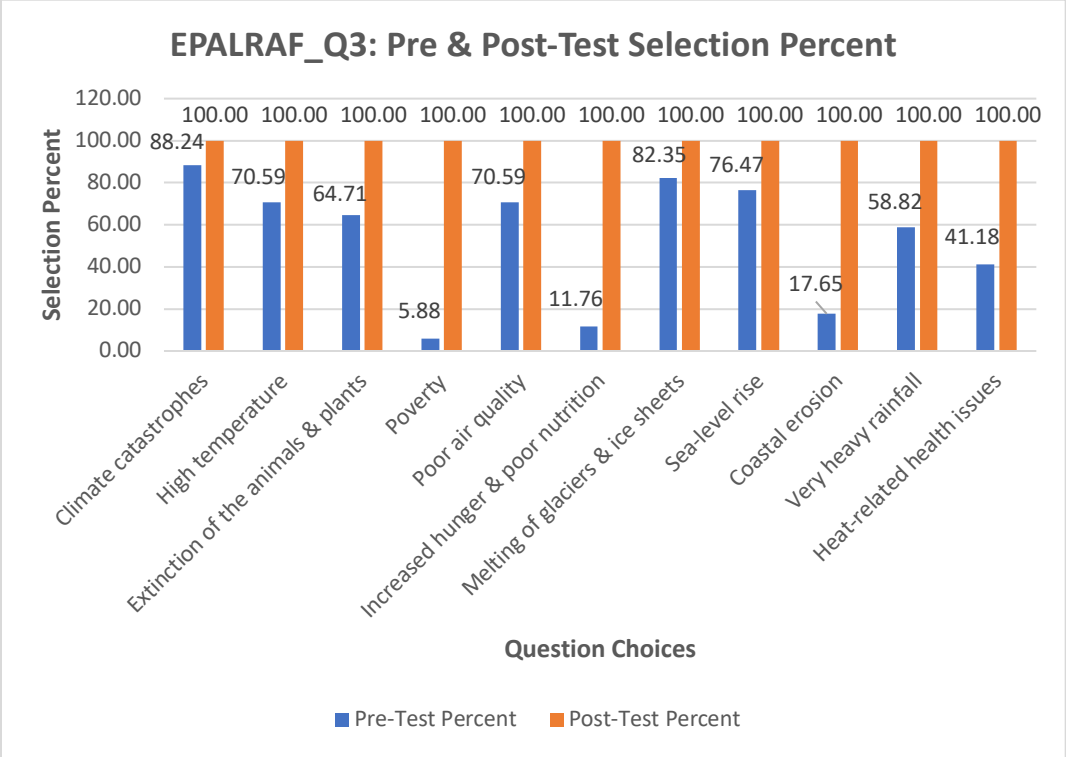
Question 3 (multiple option): What are the negative effects of climate change?

Of 11 options on negative effects of climate change, the upper secondary students selected all of them on the pre-test. The most frequently selected option was "Climate catastrophes" at 88.24%. The least frequently selected options related to

people, with the lowest being “Poverty” (5.88%) and “Increased hunger and poor nutrition (11.76%). In contrast, on the post-test, every specific option was selected by every student, so each option scored 100% (see Figure 6).

Figure 6

Third Laboratory Center of E. Attica upper secondary students: “What are the negative effects of climate change?”



Question 5 (multiple option): What do you do to prevent climate change?

Each of the answer options for “What do you do to prevent climate change” was selected by the upper secondary students on both the pre-test and post-test. On the pre-test, the most common selection was “I do recycling” (82.35%) while the least common was “I save water at home and school” (5.88%). On the post-test, the most frequently occurring option was “I save electricity at home and school” (88.24%) while the least frequently occurring options were “I save water at home and school” and “I walk or ride a bike to school” (both at 11.76%).

Cross-school Analysis

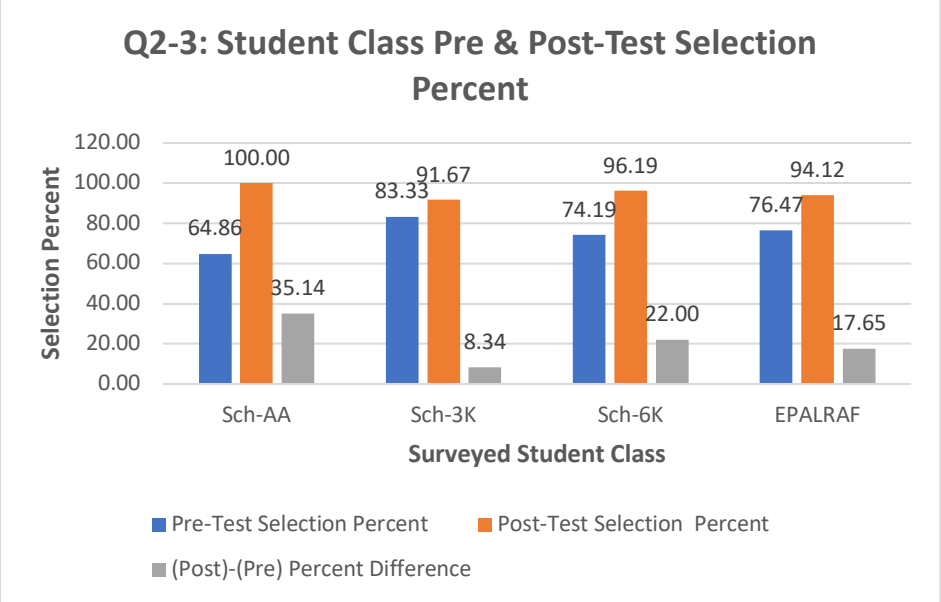
The two multiple choice questions and one of the multiple option questions were re-analysed by combining data from all the schools together.

Question 1 (multiple choice): What is a Greenhouse Gas?

The combined answers to the question "What is a greenhouse gas?" reveal that the youngest students (2nd graders from Agia Marina [Sch-AA]) made the most progress as a result of the treatment. There was an increase of 35.14% correct answers for this group (Figure 7). Interestingly, this was the only group that scored 100% on the correct answer to this question (A gas that traps heat in the earth's atmosphere) in the post-test.

Figure 7

All Schools: What is a Greenhouse Gas? (correct answer only)

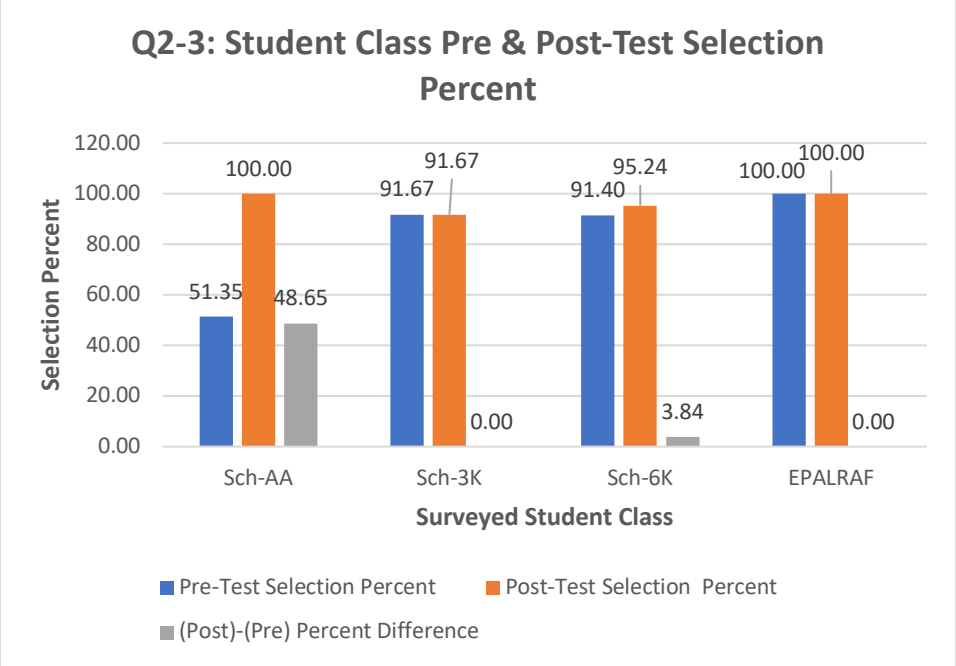


Question 2 (multiple choice): Is climate change real?

The second multiple choice question also revealed that the youngest students demonstrated the biggest increase in correct answers to the question "Is climate change real?" between the pre- and post-tests. Initially, only 51.35% of the 2nd graders selected the correct answer "Yes, climate change is taking place according to scientific findings" in the pre-test, while 100% selected the correct answer in the post-test, for an increase of 48.65%. The results are displayed in Figure 8.

Figure 8

All Schools: Is climate change real? (correct answer only)



Discussion

Impact on the Students

The Climatopia project had a positive effect on students at all grade levels, not just in terms of increased knowledge about the climate and associated behaviours, but also in terms of interaction with content, collaboration, and content creation. In terms of pre- and post-test results, the effects of the project appeared to be greater on students in the earlier grades. It is likely that the older students were already more aware of the reality of climate change and its consequences, and thus there was not as great a difference between their pre- and post-results.

One result that appeared at all grade levels was the increased awareness of the impact of climate change upon people. In the pre-test, for example, few or no students selected the options “poverty” and “Increased hunger and poor nutrition” as consequences of climate change, focusing instead on environmental effects. In the post-test, however, there was a marked increase in the number of students at all levels selecting these options. The Climatopia project, which focuses on people, has driven home to the students involved that climate change has negative effects not just on the environment but on individuals and their communities as well.

However, in addition to increased knowledge about climate change, there were other effects that were noted but not explicitly tested. For example, the report from Agia Marina notes "The Climatopia project contributed to the development of various skills, including critical thinking, decision-making, and creative expression. Students engaged in activities that stimulated their capacity for empathy, group-based decision-making, and crisis management" (p. 3). The section on pupils concludes "Pupils reported a positive psychological impact, expressing a sense of hope and empowerment in their ability to contribute to a sustainable future" (p. 4).

Kilkis Primary School shares a particularly poignant example about student engagement, particularly on the part of one struggling student:

> Characteristically, the children said that Climatopia hour was their favourite and that they wished the lesson would happen every day. What was observed by the teachers who implemented the program was that students with low academic achievement actively participated in the lessons, expressing their views orally and in writing on the worksheets. A typical case is that of a student from last year's sixth grade who exhibited very low performance in school subjects, disruptive classroom behaviour and indifference to curriculum lessons. From the first implementation of the programme, this pupil actively participated in discussions and completed the worksheets accurately in terms of structure and content. (p. 5)

Even the older students from the Third Laboratory Center of E. Attica expressed their engagement and concern about how current practices are affecting the environment:

> From the beginning of the activity the students showed a lot of interest. We could say that at first, they thought it was a bit funny and boring. However, as the plot of the story progressed, this changed. The children began to be anxious about the continuation of the plot, but also to reflect on the consequences of the climate crisis and its impact on their own lives (p. 2).

Impact on the Teachers and the School

The teachers had a critical role in this project. Not only did they facilitate the learning of their students, but they engaged in their own professional development related to climate change, the creation of comics as a pedagogical tool, and methods in nonviolent communication. In addition, they could be considered an important bridge from the classroom to the community, helping create a culture of sustainable living and enlightened policies that would promote energy awareness.

The implementation report of the Primary School of Kilkis provides a positive example of teacher engagement with the project.

> At the beginning of the year the project was presented to the school teachers in a thirty-minute presentation. The teachers seemed to be enthusiastic about the programme and especially about the way difficult concepts such as global warming were approached by the students through story and comic books. In fact, some suggested that this material should be published so that it is available in book form and can be made available to parents and teachers. (pp. 5-6).

In fact, one teacher with experience in teaching Creative Writing was so impressed with the Comic Book that she suggested "that she contribute to the transformation of the text into a theatrical work to be presented en masse to the students in the context of climate events" (p. 6).

The implementation report of Agia Marina Primary School is similarly positive. The report notes that both their teaching and their opportunities for collaboration improved:

> Teachers reported an enhancement in their pedagogical strategies through the incorporation of the Climatopia methodologies. The use of William Glasser's "Choice Theory" and Marshall Rosenberg's nonviolent communication provided them with innovative tools to engage students effectively.
>
> The teachers expressed a sense of empowerment in guiding students towards self-directed learning. The incorporation of the homonomous (connected) Self concept contributed to fostering a more holistic approach to education.
>
> The collaborative nature of the project, including peer reviews and discussions, created a supportive professional environment. Teachers found value in exchanging ideas and methodologies, contributing to professional development. (p. 3).

The Agia Marina report also discusses impact on the school as a whole: "The school community witnessed the integration of sustainable development values into the learning environment. This permeated not only the content of lessons but also the overall ethos of the school" (p. 4). The report details multiple cross-curricular initiatives that integrated education about climate change into pedagogical practices that supported sustainable education and practices. (pp 4-5).

Impact on Parents and the Community

The project clearly reverberated not only within the school but also extended to families and communities.

The implementation report of Agia Marina Primarcy School notes that "The Climatopia project encouraged parental engagement through activities that involved students at home. Parents reported positive discussions with their children about climate change, fostering a sense of shared responsibility" (p. 5).

The implementation report of the Primary School of Kilkis reports that after teachers informed the parents of the students about the project:

> the interest of the parents in the programme was evident. At this point, it is worth noting that some parents expressed the desire to implement the programme to themselves in the afternoons, so that they would have the opportunity to participate in the same activities with their children, but also to be able to discuss their common experiences at home. (p. 6)

Similarly, the implementation report of the Third Laboratory Center of E. Attica reports that when told of the project, parents "showed interest and agreed that it is a good educational activity outside the curriculum" (p. 2).

The project went beyond classroom and school walls to enhance the relationship between school and community. The Agia Marina report notes:

> The positive outcomes of the Climatopia project generated a favorable public perception of the school. The community recognized the school's commitment to providing holistic education that addresses real-world challenges. The same happened with the Directorate of Primary Education of Eastern Attica, which approved the pilot implementation.
>
> The success of the pilot test phase laid the foundation for our participation in the Erasmus+ MIRACLE project as Associate Partner Pilot School. The school community expressed interest in continuing similar projects and integrating sustainable development issues into the curriculum. (p. 6)

Students in the 5th grade from the Primary School of Kilkis had the special opportunity to educate the community when on 19 December 2023, the fifth grade students and their teacher "participated in an educational activity organised by European School Radio where they presented the programme themselves and broadcast their own message on the climate crisis on the live radio show" (p. 5).

Conclusion

The Climatopia project was successful on many levels. It educated students about climate change and taught specific strategies to help them mitigate it so we can ensure a more healthy, verdant environment in the future. It encouraged collaboration among students, between students and teachers, between teachers and the community, and among community members to work together on this authentic

initiative, thus also preparing all stakeholders for a more unified approach to other community problems in the future. It provided opportunities for student content creation that not only helps them engage with a specific topic but also helps them explore creative talents and nurture important skills and develop a positive mindset, where they feel validated because they can contribute to educating others about an urgent issue. In particular, as a result of the project, students at all levels were able to identify that climate change affects not only the environment but also people themselves. The effect of this pilot project in Greece, as well as the partner countries, bodes well for greater dissemination and future collaborations within the European Union, and beyond.

Acknowledgments

The Climatopia project in Greece is indebted to the brave teachers that agreed to pilot this important initiative and then authored a report on the experience at their school. In order of grade level, they are:

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- Maria Sofianidou, 6th Primary School of Kilkis
- George Sarrigeorgiou. 3rd Laboratory Center of East Attica

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