International Baccalaureate

Environmental Systems and Societies

How do IB Environmental Systems and Societies lessons change the students' attitudes towards global climate change in TED Ankara College Foundation Schools?

Extended Essay

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Research question: How does IB Environmental Systems and Societies (ESS) lesson change the students' attitudes towards global climate change in TED Ankara College Foundation Schools?

Introduction

Environmental education is one of the most required methods of protecting the environment. It is planned to raise awareness about physical, economic, environmental, social, and political events and changes by providing environmental education at an early age[1]. A recent study has been shown that there was a relationship between environmental education and environmental awareness, and environmental attitude[2]. Furthermore, another study has emphasized that nature experience because of its role in developing evaluation and judgment competencies is correlated with environmental knowledge[3]. For this reason, I think that understanding whether environmental education raises awareness is a starting point for solving environmental problems.

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[1]Heidari, F. and Heidari M. "Effectiveness of Management of Environmental Education on ImprovingKnowledge for Environmental Protection (Case Study: Teachers at Tehran's Elementary School)".Int. J. Environ. Res.,2015; 9(4):1225-1232.

[2]Li Y."Study of the Effect of Environmental Education on Environmental Awareness and Environmental Attitude Based on Environmental Protection Law of the People's Republic of China". EURASIA Journal of Mathematics, Science and Technology Education, 2018; 14(6): 2277-2285.

[3]Bögeholz S. "Nature experience and its importance for environmental knowledge, valuesand action: recent German empiricalcontributions". Environmental Education Research, 2006; 12(1), pp. 65–84.

Background information of Environmental Systems and Societies Lesson

Environmental Systems and Societies (ESS) is a multidisciplinary International Baccalaureate Diploma Programme (IBDP) lesson that associates many different sciences such as GeoFigurey, Ecology, Environmental Science, Chemistry and even Physics. It enables students to gain knowledge about today's most popular topics of the world, specifically environmental problems. It also examines the main causes of global warming due to anthropogenic effects from local and global perspectives and contributions to students to propose solutions to all these[4].

Background information of Climate change

Climate change can be defined as statistically significant changes in the average conditions of the climate or its variability over many years[5]. Global climate change states to the average long-term changes such as temperature rise and precipitation changes over the Earth[6].The effects of earth's warming have resulted in the development of extreme weather events, forest fires, rising sea levels, shrinking mountain glaciers, ice melting at a faster rate in Greenland[7].

[4]https://www.esstutor.net/.

[5]Turkes M. "What is Climate Change? Basic Definition, Causes, Observed and Predicted Results of Climate Change".İklim Değişikliği ve Çevre, 2008; 1, 26-37.

[6]https://www.un.org/en/climatechange/what-is-climate-change.

[7]https://climatekids.nasa.gov/climate-change-meaning/.

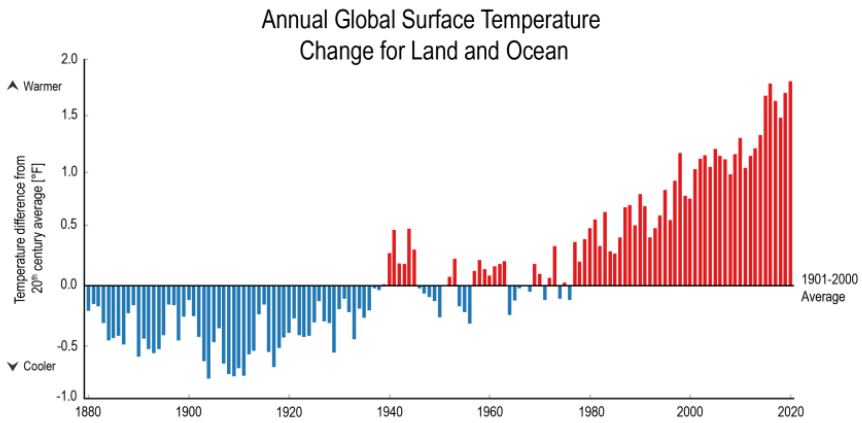

Figure 1. The number of degrees by which the average global temperature for each year differs from the average global temperature between the years 1901 and 2000 (https://www.ncdc.noaa.gov/cag/time-series/global/globe/land_ocean/ytd/12/1880-2020).

According to the sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC) 2021, the global surface temperature was 1.09 (0.95 to 1.20) °C higher in 2011-2020 than 1850-1900, and the global average sea level increased by 0.20 (0.15 to 0.25) mas the ice melted due to warming between 1901 and 2018 (Figure 1)[8].

The primary causes of temperature changes are human activities such as emissions of greenhouse gases, combustion of fossil fuels, industrial processes, land-use changes, and deforestation[5,9]. In geological times climate changes, especially glacier movements and sea-level rise changed not only the geography of the world but also the enduring ecological systems[10]. For this reason, it is important to adopt climate and environment-friendly policies by taking measures to prevent global warming, which causes climate change.

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[8]IPCC "Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V.,et al. (eds.)]". Cambridge University Press. In Press.

[9]Viola F.M.,et al."Analysis of the global warming dynamics from temperature time series. Ecological Modelling", 2010; 221: 1964–1978.

[10]Turkes M.,et al. "Küresel iklim değişikliği ve olası etkileri', Çevre Bakanlığı, Birleşmiş Milletler İklim Değişikliği Çerçeve SözleşmesiSeminer Notları", 2000: 7-24.

Aim:

The purpose of this experiment is to learn the relationship between ESS education and the students' knowledge of global climate change. With this survey, it is expected to have an idea about the differences between the situation that should be in the tackling climate change and the current situation and to understand in which areas education is needed.

Hypothesis:

The people who got ESS education will have more information about climate change and take action in order to reduce the effects of climate change. By obtaining complete and correct information about the environment and the damage to the environment with the ESS lesson in the school, the student will correct the wrong information gained from the internet. I chose this study because I wanted to emphasize the effect of education on environmental issues in order to ensure our world and future generations.

Method of investigation:

In this research, the following steps are applied respectively:

- Web research from United Nations Development Programme has been done on https://www.undp.org/ about the survey that is planned to be conducted
- Obtain the survey of environmental concern from https://www.undp.org/publications/peoples-climate-vote
- Create a survey of environmental concerns with close-ended questions.
- Involve overview and policy questions about the environment in the survey.
- Select the classes and number of students to which you will apply the survey.
- Arrange the survey covering letter according to these classes.
- This survey will be applied to 11^{th} and 12^{th}-grade high school students who are educated or not educated in ESS lessons.

- Collate the data from the survey and create tables or figures about these results.

Variables:

Independent Variable: The ESS education

Dependent Variable: The answers to the survey on climate change

Controlled Variable: Same questions in my survey on climate change, all students are in the same school, same age group, a similar number of male and female in each group

Uncontrolled Variable: The student may have information about environmental problems without education because of personal interest or nature experience (time spent in nature)

Controlled Variable Table:

Controlled Variable(s)	**How to control?**	**Why it is important to control?**
• Types of questions in the climate change survey	Everyone participating in this survey will be asked the same questions. The questions in the survey were prepared by quoting the survey of People's Climate Vote, which was held in collaboration with the United Nations Development Program (UNDP) and Oxford University's Department of Sociology.	It is important to use the same survey question because different survey questions can lead to different results and erroneous assessments.

• Students are at the same age group	Survey is applied to 11th and 12th grade students, they are at the same age group	People from different age groups may have different background on the topic due to their experiences, to prevent this students age group are selected to be same
• Similar number of male and female in each group	Students are chosen as if the females and males number will be close to each other	To prevent any possible effects of gender on the survey, students are chosen as if the females and males number will be close to each other

Uncontrolled Variable Table:

Uncontrolled Variable(s)	**Why uncontrolled?**
Student's sensitivity to environmental problems	The student may have information about environmental problems without education because of personal interest.

Materials:

My data includes first-hand knowledge of environmental concerns from my survey about climate change (attached in appendix 1). These data will be obtained from the questionnaires applied to 11^{th} and 12^{th}-grade students who have and have not received ESS education in TED Ankara College. This survey was mostly prepared by citing the People's Climate Vote held in 2020 in collaboration with the United Nations Development Programme (UNDP) and Oxford

University's Department of Sociology[11]. I did the statistical analyses by using Microsoft Excel on a computer.

Justification and Risk Assessment

Considering the global climate crisis, I chose 11th and 12th-grade high school students who are educated or not educated in ESS lessons, to emphasize the importance of the education given on environmental issues at school in my study. For this reason, I decided to organize an environmental concern survey in order to determine the relationship between environmental education levels and environmental awareness. I chose to apply a questionnaire because it is a way of gathering information from a large population and having greater statistical power. Thus, I conducted my own survey using the United Nations survey conducted in 2020 on a large population worldwide, which is a reliable source.

Ethically, I will not be using anything to harm any human or animals, but I will be classifying and comparing them. All the surveys will be confidential, and I will not be sharing any information of any participants.

[11]Flynn C., et al. "Peoples' Climate Vote". United Nations Development Programme (UNDP) and University of Oxford Department of Sociology, 2021: 1-68.

Raw Data

The results of the survey were primarily separated according to the educational status of the individuals. Accordingly, the non-ESS group has consisted of 11th-grade students whereas, ESS group is consisted of 12th-grade students in the International Baccalaureate (IB) Diploma Program (Figure 1). Then, the answers were transferred to the computer and figures were created. Evaluations and discussion were made on these charts.

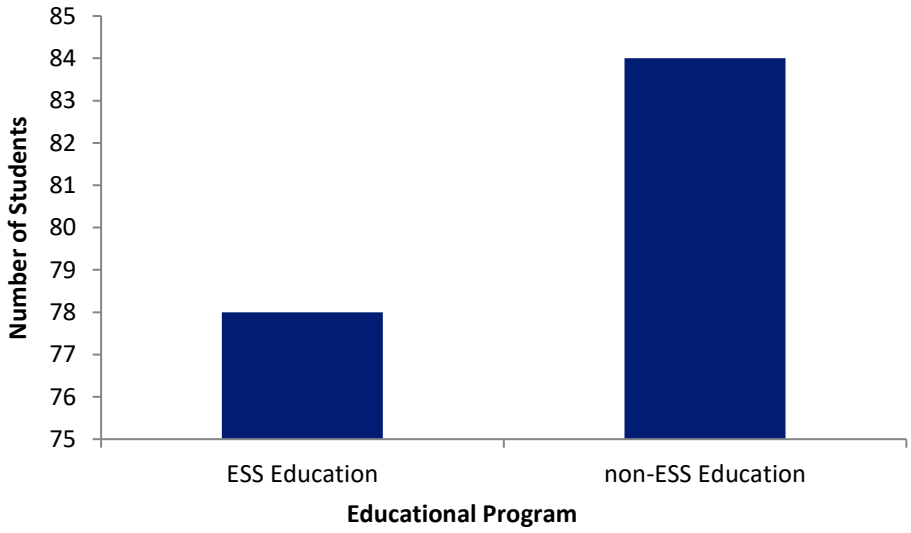

Figure 1: Number of the students who educated ESS or non-ESS lesson.

Data Processing

Results were analyzed in Excel from the questionnaires applied to 11th and 12th-grade students who have and have not received ESS education in TED Ankara College. First of all, One-way Anova was applied to find the difference among the education programs for each question. Thereafter, t-test paired samples were performed to determine the variation of the groups. Accordingly, the data of the 11th and 12th grades obtained from the survey of environmental concern are presented below. When the participants were first asked whether they believed in climate change, students answered 98.8% and 98.4% of "Yes", respectively (Figure 2).

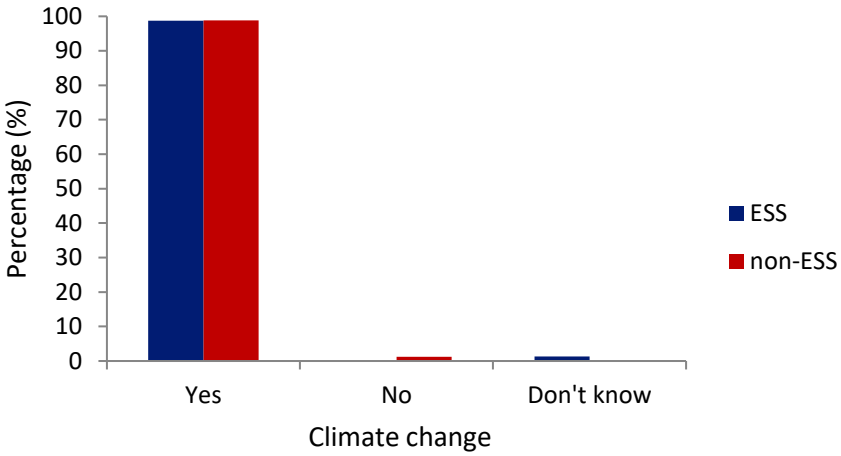

Figure 2: The percentage of the students belief in the climate change (%).

It was determined that the belief in the climate emergency was very significant in both ESS and non-ESS students. It was understood that 94.9% of the students who had received ESS education thought that climate change was a global emergency, and 5.1% thought that it was not. Besides, the non-ESS educated students, 97.6% thought that climate change is a global emergency, while 2.4% thought it did not (Figure 3).

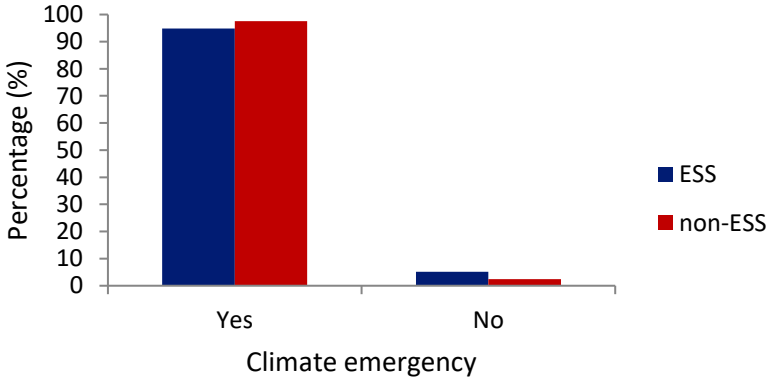

Figure 3: The percentage of the student's belief in the climate emergency (%).

The students who thought "climate change is a global emergency" were asked what the world should do about it. Expressing that climate change is a global emergency, 71.6% of the students who received ESS training suggested that the world should take necessary and urgent

measures in response, and 28.4% suggested that they act more slowly. The 79.3% of students who did not receive ESS training said that the world needed to do everything necessary and urgently in response. On the other hand, 20.7% suggested that it should be taken act slowly. Figure 3 shows students' answers to the question of “what the world should do about it”, according to their education.

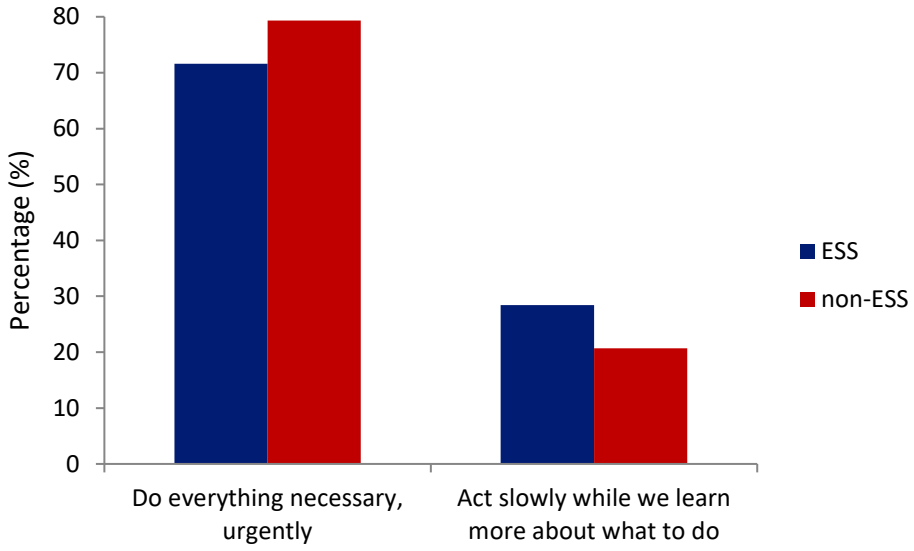

Figure 3: The percentage of the students what the world should do about climate emergency according to their ESS education (%).

When asked about the belief that climate change is contributing to an increase in extreme weather events (including droughts, floods and forest fires), 73%, 27% of the ESS educated students said "strongly agree", “agree", respectively. In addition, 70.2%, 27.4% and 2.4% of the non-ESS educated students said "strongly agree", “agree" and "don't agree", respectively (Figure 4).

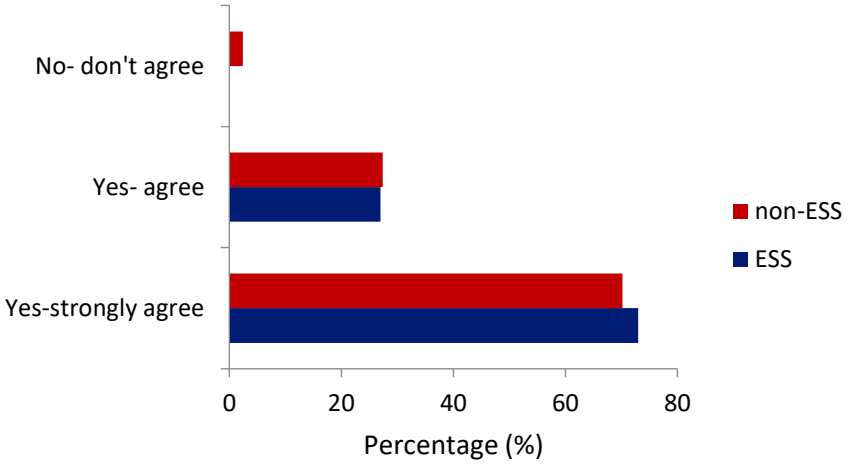

Figure 4: The percentage of the students' belief that climate change is contributing to an increase in extreme weather events (including droughts, floods and forest fires) according to their ESS education (%).

The belief that climate change is endangering species (for example, polar bears) was asked, 85.7% of the students said "yes-strongly agree" and 14.3% of the students said "yes-agree" in the non-ESS group. Similarly, 85.9%, 12.8%, and 1.3% of the students who were educated ESS said "strongly agree", "agree" and "don't agree", respectively (Figure 5).

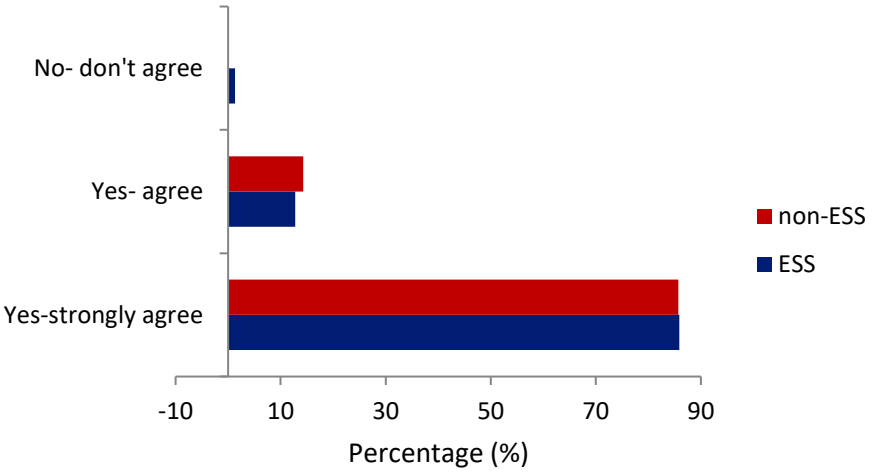

Figure 5: The percentage of the students belief in climate change is endangering species (for example, polar bears) according to their ESS education (%).

When the students in non-ESS group were asked whether they learned about climate change in high school, 83.3% of the students answered "Yes" and 16.7% answered "No", whereas the students in the ESS group of 92.2% said “Yes” and 7.8% said “No”. While 34.5% of the students in the non-ESS group who marked yes answer "very much" and 48.8% "very little", 46.1% of the students in the non-ESS group said "very much" and 46.1% "very little". The answers according to educational status are shown in Figure 6.

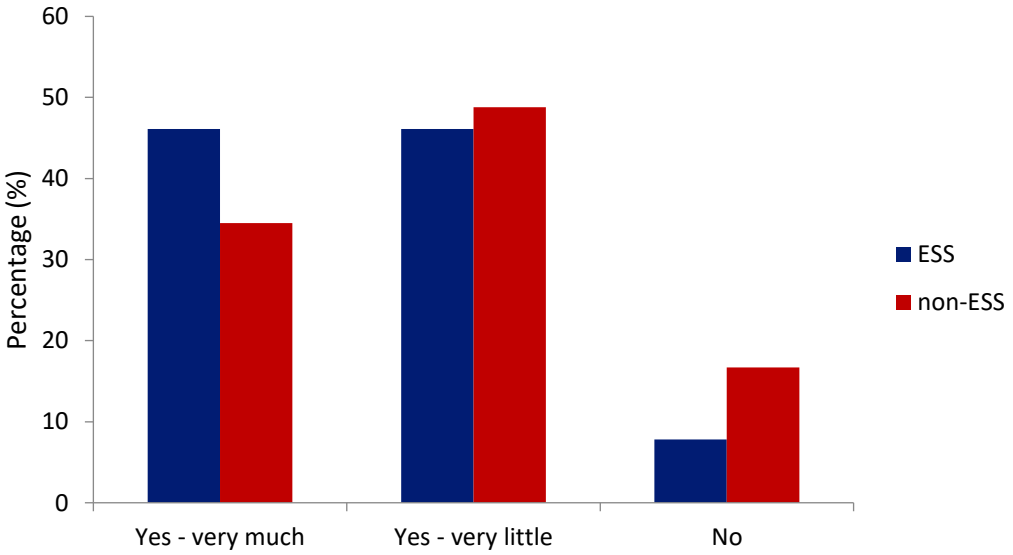

Figure 6: The percentage of the students who learned about climate change in high school according to their ESS education (%).

The ESS and non-ESS students were asked from which other sources they have learned about climate change, the answers according to the education programs of the students are shown in Figure 7.

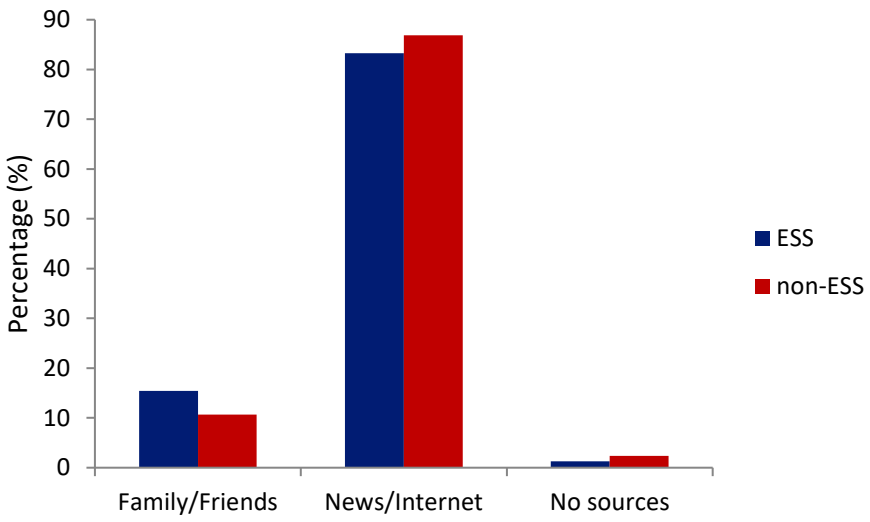

Figure 7: The percentage of the students who learned about climate change through other sources according to their education (%).

After the question was asked about their belief in the climate emergency, all students were asked which of the 18 climate policies they would like their country to follow regarding environmental concerns, regardless of their views on the subject. The proposed policies have represented some of the most important solutions to struggle with climate change. These students were offered three options for each of the six policy areas: economics, transport, energy, farms and food, and protecting people and nature. Students could select all policies or none at all.

When energy policies about climate change were asked, 17.9%, 7.1%, 1.2% of the students in the non-ESS group were answered “use renewable energy such as solar and wind”, “reduce energy consumption in homes, buildings, and factories”, “stop using polluting fuels”, respectively. Similarly, 17.9%, 2.6%, 2.6% of the students in the ESS group said “use renewable energy such as solar and wind”, “reduce energy consumption in homes, buildings, and factories”, “non of the above", respectively. In addition, 71.4% of the non-ESS students

and 76.9% of the ESS students marked the “all of the above” option. Figure 8 presents energy policies about climate change by educational programs.

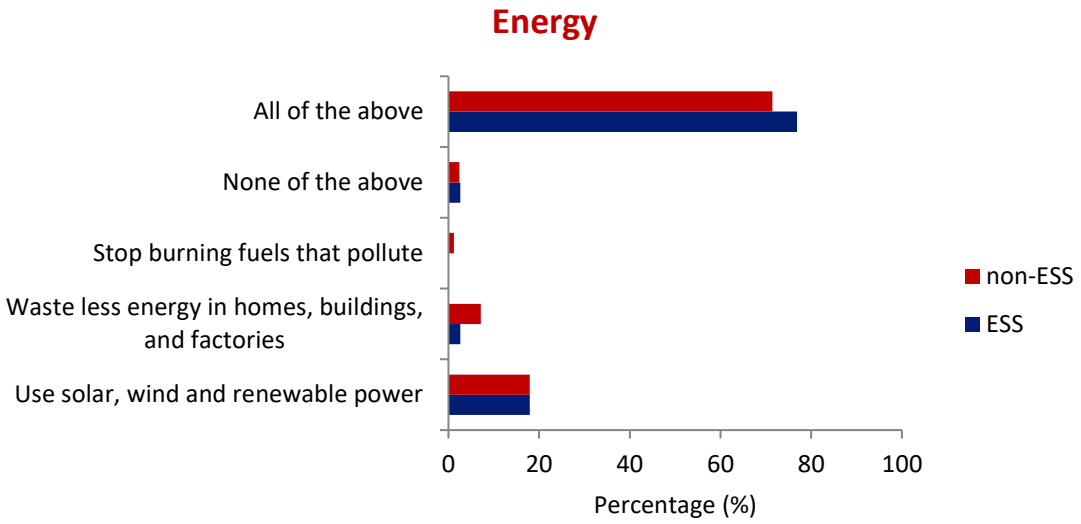

Figure 8: Percentage of the students who considered what their government should do about the energy to address the climate crisis according to their educations (%).

Economy policies were asked to students and 27.4%, 5.9%, 4.8% of non-ESS students and 23.1%, 2.6% and 7.7% of ESS students answered “invest more in green businesses and jobs”, “learn more about how products are made”, “make companies pay for their pollution”, respectively. All the answers given by the students about the economic policies according to their education programs are shown in Figure 9.

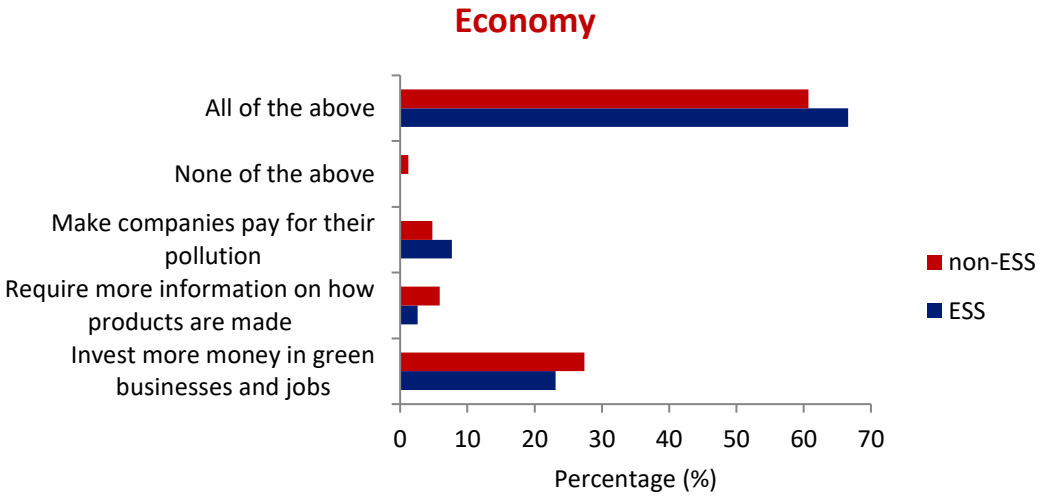

Figure 9: Percentage of the students who considered what their government should do about the economy to address the climate crisis according to their educational programs (%).

About transportation policies,19%, 8.3%, 3.6% of the non-ESS students and 16.6%, 2.6% and 2.6% of the ESS students said "use more clean electric cars and buses or bicycles", "transport good on planes, ships, trains and trucks that run on clean energy", "improve the design of cities and rural communities", respectively. Most of the students in the ESS and non-ESS group have thought that all transportation policies given should be done. All the answers given by the students about the transportation policies according to their education programs are shown in Figure 10.

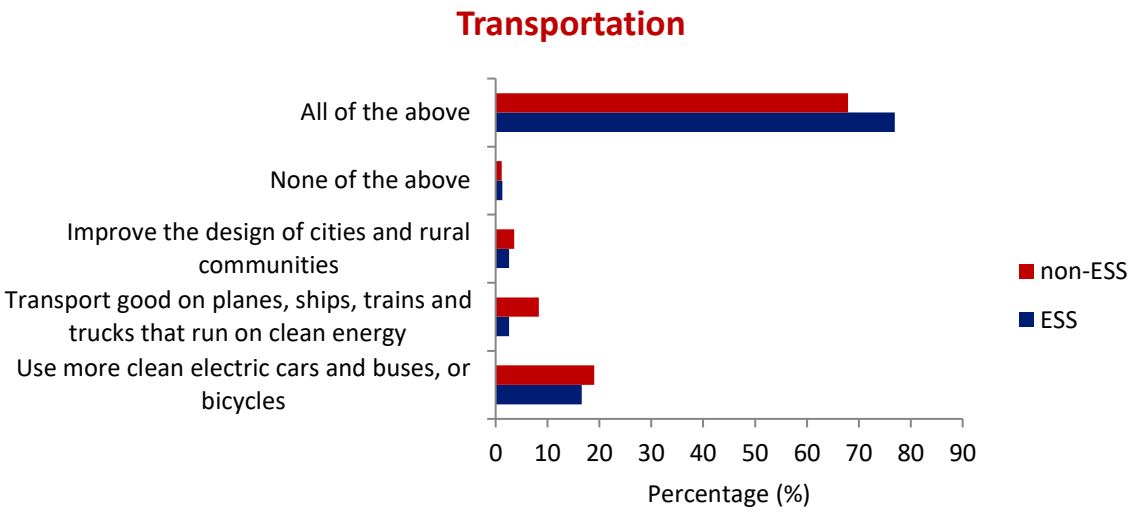

Figure 10: Percentage of the students who thought how should your country improve transport to address the climate crisis according to their educational programs (%).

Farms and food policies were asked to students and 32.1%, 9.5%, 2.4% of the non-ESS students and 20.5%, 14.1%, 2.6% of the ESS students answered “Use climate-friendly farming techniques”, “reduce food waste”, “promote plant-based diets”, respectively. All the answers given by the students about the farms and food policies according to their education programs are shown in Figure 11.

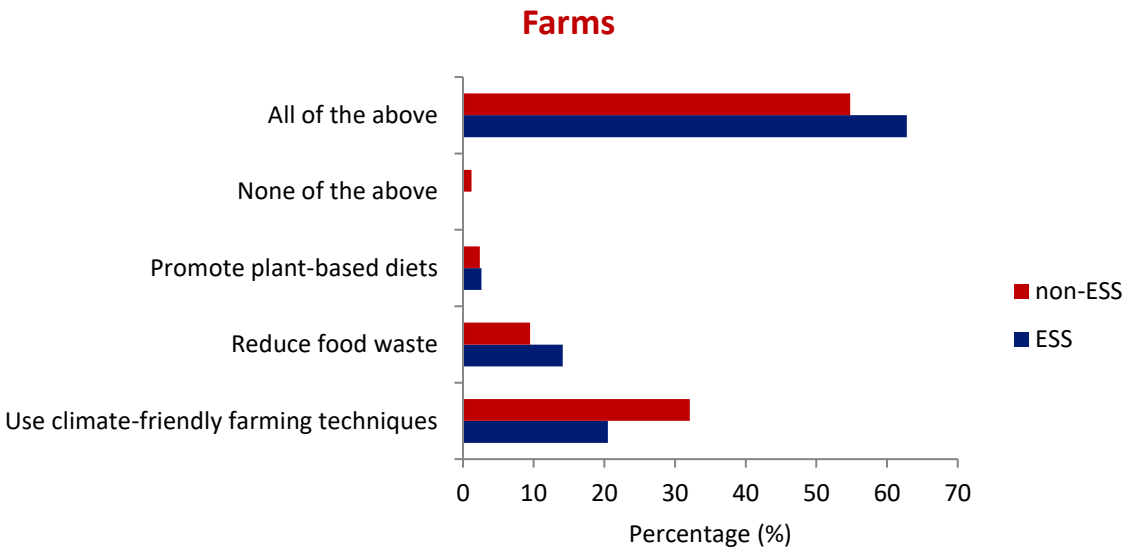

Figure 11: Percentage of the students who considered what their government should do about the farms and food to address the climate crisis according to their educational programs (%).

All students were asked how their country could better protect their people from floods, droughts, severe storms, wildfires and other climate influences, with 70.2% of non-ESS students and 67.9% of ESS students answering "all of the above". Figure 12 presents protecting people's policies about climate change by educational programs.

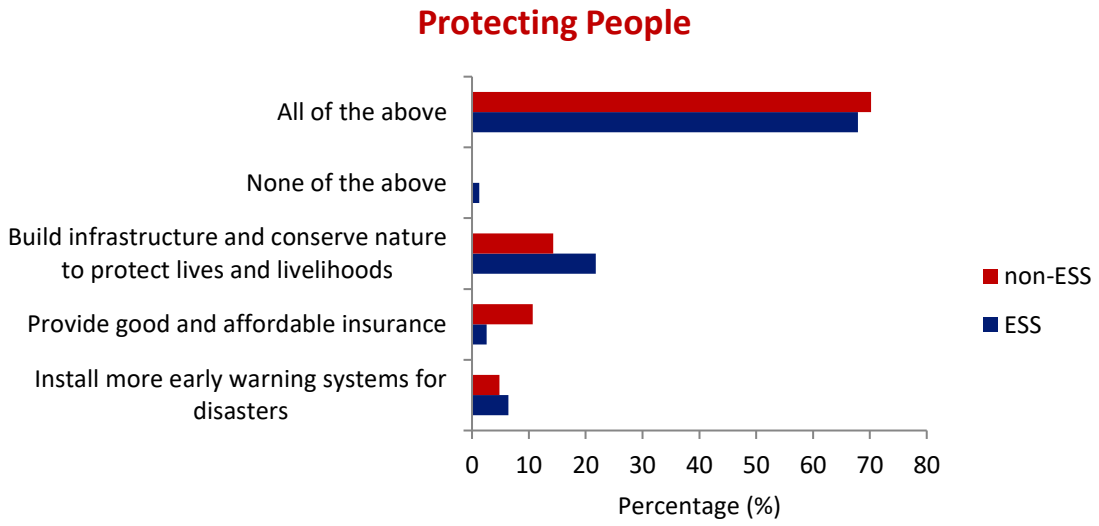

Figure 12: Percentage of the students who thought how should your country better protect from extreme climate change impact according to their educational programs (%).

When asked what they think needs to be done about the nature of their country, 83.3% of the non-ESS students and 83.3% of the ESS students thought that all options should be done. Figure 13 shows nature policies about climate change by educational programs.

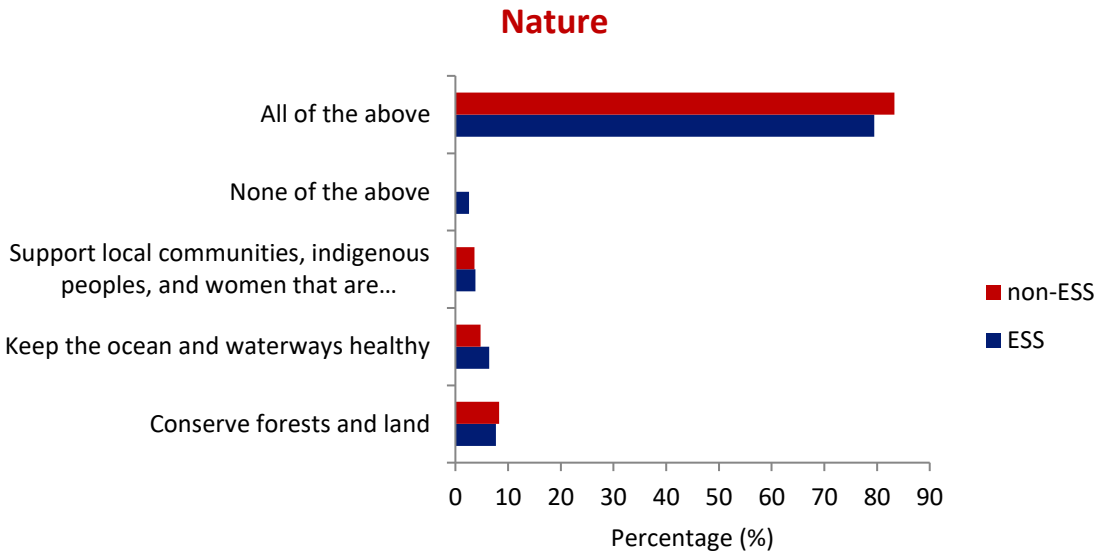

Figure 13: Percentage of the students who considered what their government should do about the nature to address the climate crisis according to their educational programs (%).

It is understood that the most important socio-demographic factor of belief in a climate emergency and climate action is a person's educational background. Considering the causes and consequences of climate change, there is a difference of opinion among all students according to their educational status in my survey study. The global emergency of climate change and what the world should do about it and contribution to the increase in extreme weather events were compared between the education programs, there was no significant difference ($P>0,05$) (Figure 3). However, most of the students in all educational programs agreed that everything necessary should be done urgently. Furthermore, the ESS educated students said that they learned more about climate change at school, compared ton on-ESS educated students ($P<0.05$) (Figure 6). Additionally, most of the students stated that they also learned about climate change through the news/internet (Figure 7).

When environmental policies are evaluated in the ESS group, the students mostly think that all policies in the survey should be implemented compared to non-ESS students. On the contrary, the majority of the non-ESS students said that all nature policies should be implemented compared to ESS students (Figure 13). Considering not asking the nature experiences of the students participating in this survey, it may be concluded not to evaluate nature policies exactly.

In conclusion, according to this survey results, it can be said that most of the students have an opinion of climate change. Considering to ESS students learned more about climate change at school, it was concluded that the ESS course contributed significantly to the approaches to combating climate change. In addition, I believe that more precise information can be obtained by expanding this survey study with more students and more questions.

Discussion:

Global climate change is an issue that has seriously occupied the world since the 1980s. Especially, atmospheric concentrations of main greenhouse gases have been significantly increased as a result of various human activities such as combustion of fossil fuels, industrial processes, land-use changes, and deforestation over the years. As a consequence of the increased greenhouse effect, an additional positive radiative forcing is created on the energy balance of the Earth and the Earth's climate is warming[5].

People's recognition of the urgency of the climate change problem is very important for increasing their adaptation and preparedness to climate change. For this reason, environmental education has become the most effective method of raising awareness and knowledge to deal with future environmental challenges. Environmental attitudes and behaviors begin to form from an early age and continue until the end of an individual's life. Therefore, giving environmental education courses in schools play an active role in creating new behavioral

patterns for students. Our National Curriculum gives education on climate change at the end of year 10. Students gain a superficial perspective about the topic at the end of 10th grade. The result of this extended essay shows us that the information given is sufficient. In another current study, it has been revealed that teachers teaching students about environmental problems can play a controlling role in society to protect the environment in the long and medium-term[1].

Demographic information about age, gender, and education levels was requested in the Peoples' Climate Vote survey, which was conducted in 50 countries between 7 October and 4 December 2020. This climate emergency recognition survey showed a high degree of consistency among people with post-secondary education in all these countries[11]. In my study, similar to other studies, it was observed that there is a relationship between environmental education and environmental awareness. According to the results of this survey, it can be said that especially IB students who learn the ESS course are more sensitive to the environment than the students in other education programs, thus supporting my hypothesis.

Evaluation:

Strength(s)	**The reason it's believed to be a strength**
One independent variable used	This allowed me to focus on my research question and investigation so I could better assess its implications.
The survey is applied to students of 11th and 12th grade in high school.	In survey studies, the sample size is important to reach comprehensive results. I applied a survey to similar numbers of girls and boys in both 11th and 12th grades. This standardised the data.

The importance of media	This study shows that media is the one of the important factors other than education.
The sufficiency of national curriculum about climate change education	Since the questions of the survey are broad, it can be stated that national curriculum about climate change education is sufficient to have general information.

Limitation(s)	**Effect of Limitation on the Result of Investigation**	**Suggested improvement and why it will improve the investigation**
The survey was applied to a limited number of students.	I only gained insights into specific classes of the school.	I should have taken more surveys to have more data and accuracy.
Selection of classes	I only picked two classes in the same school: 11^{th} and 12^{th}-grade.	I could have chosen more different schools for the students.
Quality of the questions	Questions are taken from a reliable source however it is not required to know the details of the topic to answer some of the questions, so results of two groups are close.	To see the effect of ESS education more, information-based questions, details of the topic could be asked.
Choices at the policy question part	"All of the above" and "none of the above" are the two	Excluding those two choices from the survey.

	choices of the policy questions. When students don't know a lot about the topic, they always tend to choose those choices. It could mask the actual responses of the students	

How to improve the study

To see the actual effect of education on the attitudes against global warming, different age groups could be used.

Another choice is to apply a pre-test before giving education about the topic for couple of weeks and then apply post-test. This education could be given to smaller age group students to see the effect of education only, excluding the effect of media.

Conclusion

The research question is "How do IB Environmental Systems and Societies lessons change the students' attitudes towards global climate change in TED Ankara College Foundation Schools?". This extended essay shows us that education is important while increasing awareness on climate change, at the same time, how media effects people's education levels on certain topics such as climate change. With the effect of the media my results came really close to each other. Also, this extended essay can be used to show that giving eduction in a very early age can affect the awareness about the climate change. And this study can be given as evidence to importance of education about climate change. We should continue to give education about climate change and, we could start giving eduction about climate change from an early age.

APPENDIX 1

SURVEY OF ENVIRONMENTAL CONCERNS

OVERVIEW QUESTIONS

1. What grade are you in?

a. 11

b. 12

2. Are you female or male?

a. Female

b. Male

3. In school which of these programmes are you in?

a. International Baccalaureate (IB) Diploma Programme (MF)

b. International Baccalaureate (IB) Diploma Programme (TM)

c. Academic Science Programme

d. National Programme

4. You likely have heard of the term climate change.

Climate change, including global warming, refers to the idea that the Earth's average temperature is rising, and is resulting in changes in the weather and climate. Do you believe that climate change is happening?

a. Yes

b. No

c. Don’t know

5.Do you think climate change is a global emergency?

a. Yes

b. No

6. If yes, what should the world do about it?

a. Do everything necessary, urgently

b. Act slowly while we learn more about what to do

c. The world is already doing enough

d. Do nothing

7. Do you believe that climate change contibutes to the increase in extreme weather events (including droughts, floods and wildfires)?

a. Yes-- strongly agree

b. Yes-- agree

c. No-- don't agree

d. Don't know

8. Do you believe that climate change is endangering species (for example, polar bears)?

a. Yes-- strongly agree

b. Yes-- agree

c. No-- don't agree

d. Don't know

9. In high school, are you learning about climate change?

a. Yes - very much

b. Yes - very little

c. No

10. Have you learned about climate change through other sources? If so, please check all which apply.

a. Yes - Family/Friends

b. Yes - News/Internet

c. No sources

d. Yes Other (please specify)……

POLICY QUESTIONS

1. Energy: To address the climate crisis, what should your country do about energy?

a. Use solar, wind and renewable power

b. Waste less energy in homes, buildings, and factories

c. Stop burning fuels that pollute

d. None of the above

e. All of the above

2. Economy: To address the climate crisis, what should governments do about the economy?

a. Invest more money in green businesses and jobs

b. Require more information on how products are made

c. Make companies pay for their pollution

d. None of the above

e. All of the above

3. Transportation: To address the climate crisis, how should your country improve transport?

a. Use more clean electric cars and buses, or bicycles

b. Transport good on planes, ships, trains and trucks that run on clean energy

c. Improve the design of cities and rural communities

d. None of the above

e. All of the above

4. Farms and food: To address the climate crisis, what should governments do about farms and food?

a. Use climate-friendly farming techniques

b. Reduce food waste

c. Promote plant-based diets

d. None of the above

e. All of the above

5. Protecting People: How can your country better protect people from extreme storms, flooding, droughts, forest fires, and other climate impacts?

a. Install more early warning systems for disasters

b. Provide good and affordable insurance

c. Build infrastructure and conserve nature to protect lives and livelihoods

d. None of the above

e. All of the above

6. Nature: To address the climate crisis, what do you think your country should do about nature?

a. Conserve forests and land

b. Keep the ocean and waterways healthy

c. Support local communities, indigenous peoples, and women that are environmental stewards

d. None of the above

e. All of the above

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