

Co-funded by the
Erasmus+ Programme
of the European Union



Grant Agreement No 2020-1-EL01-KA226-HE-094691



EDUCATOR GUIDE

- Climate Change -

PART OF THE INTELLECTUAL OUTPUT 3

Authors : Emily Michailidi, Eleni Botzaki, Athanasia Kokolaki, Dimitris Stavrou



STEM Digitalis project has been funded with the support of the European Union and the Greek National Agency within the framework of the Erasmus+ Programme

(Grant Agreement n°2020-1-EL01-KA226-HE-094691).

The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.


Table of contents

Chapter 1: Introduction	4
Chapter 2: Why Climate Change education?	5
Chapter 3: Structure of the digital scenario	6
Chapter 4: Implementation	8
Unit 1: Relationship between carbon dioxide concentration and temperature rise	8
Activity 1.1	8
Activity 1.2	8
Activity 1.3	10
Unit 2: Anthropogenic activities that contribute to CO2 concentration levels rise	10
Activity 2.1	10
Activity 2.2	11
Activity 2.3	12
Activity 2.4	13
Unit 3: Lignite phase out: Agree or Disagree?	13
Activity 3.1	13
Activity 3.2	14
Activity 3.3	15

Chapter 1: Introduction

This document serves as an Educator’s Guide for the implementation of the Climate Change scenario.

It contains an overview of the Climate Change scenario structure and after that a detailed description of each individual unit and activity. Each activity is described in terms of a five-dimensional framework, providing information about the activity’s timing, mode, approach, group synthesis and the kind of media used (for more details please see IO2).

	<p>Icon used to indicate information about the way of conducting each activity in terms of the 5-dimensional framework</p>
---	--

Moreover the Educator’s Guide includes hints for the instructors, indicating possible pre-service teachers’ difficulties and ways to help them overcome them. These hints are indicated by a green frame, as shown in Figure 1.

Hint:

The use of shared documents supports the comparison of pre-service teachers’ initial ideas expressed in Activity 1 with their final conclusions formulated in Activity 3 of Unit 1.

Fig. 1 Example of a “Hint box”

Finally, suggestions of alternative ways to conduct each activity, for example if someone wants to implement the Climate Change digital scenario fully on-line, are also provided. These alternatives are indicated by an orange frame, as shown in Figure 2.

Alternative:

Activity 3 can also be conducted in an on-line synchronous mode. In that case the educator should use a teleconference application that provides separate virtual rooms for pre-service teachers to firstly discuss with their peers their views and then present them to the whole group.

Fig. 2 Example of an “Alternative box”

Chapter 2: Why Climate Change education?

Climate change education is crucial for pre-service primary education teachers and science educators as climate change constitutes a global challenge with far-reaching impacts. Teachers have a significant role in shaping future generations' perspectives and knowledge. By equipping pre-service teachers with climate change education, we empower them to effectively educate their students.

For science educators, understanding climate science is fundamental as they play a role in nurturing scientific literacy. Ensuring that science teachers possess comprehensive knowledge of climate science is essential for delivering accurate and thorough instruction on the subject. However, climate change is not solely a scientific concern; it has social, economic, and political dimensions. pre-service teachers need a holistic understanding of climate change that will allow them to seamlessly integrate it into various subjects and help students recognize its relevance in their daily lives.

Climate change education should not merely focus on the problem but also emphasize solutions. pre-service teachers must comprehend mitigation strategies and adaptation measures. Equipped with this knowledge, they can effectively transmit practical information to their students, providing them with the tools to address climate change. Moreover, teachers have an ethical responsibility to prepare students to be responsible global citizens and reflect critically upon pressing socioscientific issues raised by either the effects of climate change or the mitigation measures taken.

Ultimately, climate change education empowers teachers to empower their students. It fosters critical thinking skills, informed decision-making, and active engagement in discussions and actions that can drive positive change. In summary, climate change education is vital for pre-service teachers, enabling them to educate future generations about this critical issue while promoting scientific literacy, interdisciplinary thinking, and ethical responsibility among students.

Chapter 3: Structure of the digital scenario

The Climate Change digital scenario consists of three Units:

- Unit 1: Relationship between carbon dioxide concentration and temperature rise
- Unit 2: Anthropogenic activities that contribute to CO₂ concentration levels rise
- Unit 3: Lignite phase out: Agree or Disagree?

Through *Unit 1* pre-service teachers are introduced to core climate change concepts by reading texts (newspaper articles) about the decisions taken worldwide concerning the call for Climate Change action. Then they collect and compare data concerning temperature and CO₂ concentration rise through decades of 80's, 90's, 00's and 10's in order to form conclusions about global trends and explore the correlation between the global temperature rise and the CO₂ concentration rise.

In *Unit 2* pre-service teachers elaborate on the annual CO₂ emissions of their country. Afterwards, they delve into their own contribution to CO₂ emissions, calculating their carbon footprint. At the end of this unit, they are expected to form conclusions regarding the effect of the use of Renewable Energy Sources (RES) on CO₂ emissions.

Through *Unit 3* pre-service teachers elaborate on socioscientific issues that are related to climate change. In particular, they formulate and express their arguments regarding the complete shut down of a lignite –fired power plant and the construction of new wind farms and solar panel parks instead. Before making their decisions, they explore the multiple perspectives around the SSI under examination through an AR Treasure Hunt activity.

These three Units can be used independently, however, the suggested sequence, in the event that a teacher wishes to implement all three, is as presented in Figure 3:

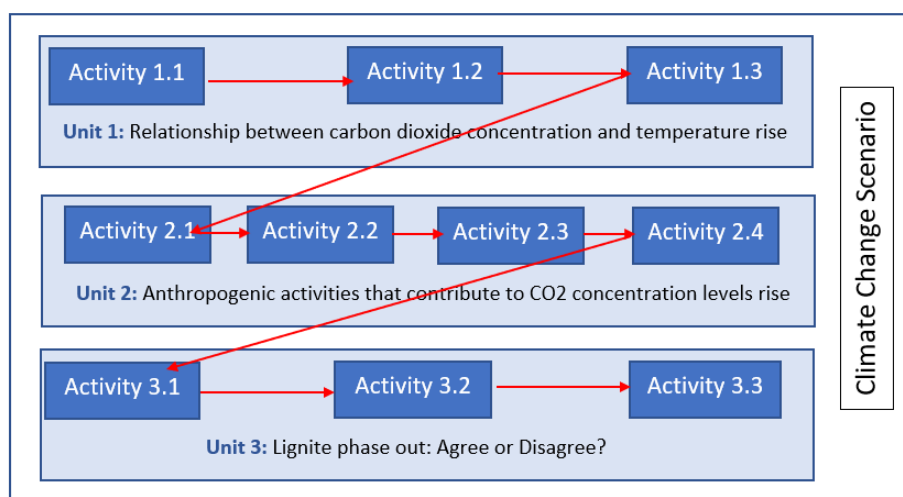


Figure 3. Proposed sequence for Climate change scenario Units & Activities



As indicated from Figure 3, each Unit consists of individual activities which will be presented in detail below.

Chapter 4: Implementation

Unit 1: Relationship between carbon dioxide concentration and temperature rise

Activity 1.1

The first activity of the Unit includes a brief lecture on climate change core concepts and a newspaper texts' analysis on policies regarding climate crisis. Then pre-service teachers discuss and communicate to the whole group their initial ideas about the core concepts under examination through shared documents.

Hint:

The use of shared documents supports the comparison of preservice teachers' initial ideas expressed in Activity 1.1 with their final conclusions formulated in Activity 1.3.



Activity 1.1 is mostly led by the teacher and it is suggested to be conducted in a synchronous, face-to-face session and pre-service teachers to work in groups, as they are called to discuss their views with their peers and afterwards to communicate them to the plenary. The digital media used in this activity are:

- Internet resources :
 - <https://www.nytimes.com/2021/10/31/world/europe/g20-climate-temperature-rise.html>
 - <https://www.bbc.com/news/world-europe-56828383>
- Shared document:
 - https://docs.google.com/document/d/1xC9xbXiZDmjywtpnYHLe8L1spicAMkCd/edit?usp=drive_link&oid=11351382208696621996&rtopf=true&sd=true

Alternative:

Activity 1 can also be conducted in an on-line synchronous mode. In that case the educator should use a teleconference application that provides separate virtual rooms for pre-service teachers to firstly discuss with their peers their views and then present them to the whole group.

Activity 1.2

The second activity of the unit includes the elaboration on the core concepts under examination via the serious game and the other tools integrated into the game. Specifically, pre-service teachers via charts integrated into the STEM Climate Change game collect and compare data concerning temperature and carbon dioxide concentration rise through decades of 80's, 90's, 00's and 10's. In addition, pre-service teachers explore the correlation between the global temperature rise and the carbon dioxide concentration rise via an integrated interactive video experiment created in the H5P platform and share their conclusions via shared dashboards.

Hint:

Pre-service teachers may face difficulties in collecting data from the integrated charts and matching the charts with the corresponding decade without any guidance from the instructor. It would be useful for the instructor to present the html -based graphs independently outside the game environment to familiarize pre -service teachers with how to read the respective data.



Activity 1.2 is student -led and and it is suggested to be conducted asynchronously in pre -service teachers' own time and space. As the serious game has not an embedded chat or voice chat feature pre -service teachers will work individually. Their only interaction is conducted asynchronously by reading each others' comments in the shared dashboard regarding the interpretation of observations and conclusions on the correlation between the global temperature rise and the CO2 concentration rise. The digital media used in this activity are:

- Serious Game:
 - https://stemdigitalis-project.eu/unityGame_UoC.zip
- Interactive experiment (embedded in the serious game):
 - <http://h5p.edthe.edc.uoc.gr/co2-stemdigitalis/>
- Html tools (embedded in the serious game):
 - <https://edthe.edc.uoc.gr/climateChange/co2.html>
 - <https://edthe.edc.uoc.gr/climateChange/temp.html>

Alternative:

Another way for pre-service teachers to overcome the aforementioned difficulties is the implementation of the serious game to take part synchronously in a face-to-face session in order for the instructor to provide the necessary hints and guidance during the procedure. In this way pre-service teachers can also work in groups assisting each other in elaborating on the core concepts of climate change.

Activity 1.3

The third activity of the unit includes pre-service teachers' reflection on global temperature rise and the carbon dioxide concentration rise and their relationship as well as on the political decisions of G20 leaders and European Commission via shared documents.



Activity 1.2 is teacher-led and it is suggested to be conducted in a synchronous, face-to-face session and pre-service teachers to work in groups, as they are called to discuss their views with their peers and afterwards to communicate them to the plenary. The digital media used in this activity are:

- Shared document:

- https://docs.google.com/document/d/1fhntiuKeaOqkvCwZVzBS0vu_8RvexBKZ/edit?usp=drive_link&oid=113513822086969621996&rtpof=true&sd=true

Alternative:

Activity 1.3 can also be conducted in an on-line synchronous mode. In that case the educator should use a teleconference application that provides separate virtual rooms for pre-service teachers to firstly discuss with their peers their views and then present them to the whole group.

Unit 2: Anthropogenic activities that contribute to CO₂ concentration levels rise

Activity 2.1

The first activity of the unit includes the introduction of the unit and an initial exploration of data about a) the amounts of CO₂ emissions per European country in 2020 and b) the CO₂ emissions per anthropogenic activity in each country via two interactive maps.



Activity 2.1 is teacher-led and it is suggested to be conducted in a synchronous, face-to-face session and pre-service teachers to work in groups, as they are called to discuss their views with their peers with the support of a digital worksheet. The digital media used in this activity are:

- Interactive images / maps:
 - <https://view.genial.ly/62c86a4d281281001128ef94/interactive-content-copy-eyrwpaikos-xarths-ekpompwn-co2>
 - <https://view.genial.ly/62c839b8d7de75001c4644bb/interactive-content-copy-eyrwpaikos-xarths-ekpompwn-co2>
- Shared document:
 - <https://docs.google.com/document/d/1tPmwG5hEtIQG4Ep2gvrhxd3uBSlpOgDS/edit?usp=s haring&oid=104008878054060366347&rtpof=true&sd=true>

Alternative:

As pre-service teachers could easily read the maps and conduct the activity without instructor's guidance and feedback, Activity 2.1 can be also implemented asynchronously, in an online mode with students working individually.

Activity 2.2

The second activity of the unit includes pre-service teachers' calculations of their CO₂ emissions (carbon footprint) that are due to household appliances & urban transportation via the Carbon digitalis mobile app. After their calculations, they were asked to share their results in a menti poll in a face-to-face session so as the whole group to have access to the results of each student in advance. After the calculations and sharing, a discussion took place with the whole group. Pre-service teachers had access to the carbon footprint results of all their peers and thus were able to fruitfully discuss and compare their results as well as the reasons for the differences among their results.

Hint:

In order pre-service teachers to be able to support their arguments for the face-to-face discussion with evidence on their peers' amounts of CO₂ emissions it is important to share with them in advance everyone's results of their carbon footprint calculations.

As derives from the aforementioned description Activity 2.2 consists of two parts. In the first part of the activity, which is student-led, pre-service teachers asynchronously and individually calculate their carbon footprint, arriving at a final result. In the second part of the activity,



which is conducted in a face-to-face session led by the teacher, pre-service teachers work in groups, as they are called to discuss their views with their peers with the support of a digital worksheet. The digital media used in this activity are:

- “Carbon Digitalis” mobile app
 - https://apkdownload.com/Carbon-Digitalis/appinventor.ai_chalkia_duck.CarbonDigitalis.html
- Jamboard:
 - <https://docs.google.com/document/d/1W80RAK6jGLByRCSmKwIKRz9s5FGnQcmvqPW-O8ZyJE/edit?usp=sharing>

Alternative:

Activity 2.2 can be conducted in a fully on-line mode. However it is important to maintain the synchronous sharing of results and discussion. In that case the educator should use a teleconference application to share synchronously the results from the ment i polls and for pre-service teachers to discuss their views with their peers.

Activity 2.3

The third activity of Unit 2 includes pre-service teachers’ exploration of data about the per capita CO₂ emissions in each country via an interactive map as well as the comparison of this data with their own average daily CO₂ emissions and the sharing of their views via shared dashboards.

Hint:

Shared dashboards (eg. Padlet) allow comments in each participant’s answer providing the opportunity for asynchronous interaction and creating an informal forum environment. Therefore pre-service teachers didn’t lack interaction while sharing their views despite the on-line format of the activity.

Subsequently, pre-service teachers were called to calculate and compare their daily CO₂ emissions from their household activities, if the production of the respective amount of energy was based solely on different types of RES.

Hint:

These calculations are quite demanding for pre-service primary teachers so a previous explanation of the equation and the modeling of a relevant example is suggested.



Activity 2.3 is led by pre-service teachers themselves as it is conducted fully on-line and asynchronously while pre-service teachers work individually to explore data about the per capita CO₂ emissions of their country and to calculate their daily CO₂ emissions with the use of RES. The digital media used in this activity are:

- Interactive images / maps:
 - <https://view.genial.ly/62c86a4d281281001128ef94/interactive-content-copy-eyrwpaikos-xarths-ekpompwn-co2>
- Shared documents:
 - https://docs.google.com/document/d/1bKeMTmKXHhix4PRmEBVxl9tdbzT7eOgd/edit?usp=s_haring&oid=104008878054060366347&rtpof=true&sd=true

Alternative:

Activity 2.3 can also be conducted in a face-to-face session with pre-service teachers working either individually or in groups with their peers. In this case the only digital media needed will be the interactive map while the rest of the activity can be carried out analogously.

Activity 2.4

The fourth activity of Unit 2 includes a discussion regarding the role of RES in mitigating climate change. Students draw conclusions on the contribution of RES in mitigating CO₂ emissions based on the results of Activity 3.



Activity 2.4 is led by the instructor in a face-to-face, synchronous session during which the pre-service teachers work in groups. There is no need for use of digital media, so the activity is carried out analogously.

Alternative:

The final part of Unit is recommended to be implemented face-to-face so as the instructor to guide the discussion and argumentation process. However, if needed, the discussion can

be conducted through the use of a teleconference system for the purposes of an on-line implementation.

Unit 3: Lignite phase out: Agree or Disagree?

Activity 3.1

The first activity of Unit 3 includes an exploration of the fossil fuel's mix in diverse European countries as well as an exploration of the reasons for the high rate of using lignite in Greece. Pre-service teachers initially explore the concept of gross available energy as well as the percentage of fossil fuels in gross available energy in diverse European countries and subsequently, they search and share with their peers the reasons for the high rate of using lignite in Greece via shared dashboards.

Hint:

This activity serves as a preparation for the debate pre-service teachers are called to be involved in during the Activity 3.3.



Activity 2.4 is led by the instructor in a face-to-face, synchronous session during which the pre-service teachers work individually. The only digital media used is a presentation. (https://docs.google.com/presentation/d/1YXqMWNVIAwYoHwAGw0o_qWJocW5U3K0I/edit#slide=id.p33)

Alternative:

Activity 3.1 can also be carried out in an on-line synchronous session.

Activity 3.2

The second activity of Unit 3 includes the exploration of multiple stakeholders' perspectives on the lignite - phase out. Pre-service teachers are called to formulate their view regarding the lignite-fired power plants complete shut down and their replacement with wind farms and solar panel parks. In order to do so, they are called to discover different stakeholders' perspectives by taking part in a "treasure hunt" AR-based activity. Pre-service teachers are provided with riddles which correspond to diverse stakeholders such as the European Union,

the non - governmental organizations, the activists, the locals, the researchers and the RES company CEO. These riddles lead them to specific images around the place where the “treasure hunt” activity takes place. When pre-service teachers identify and match the stakeholder with the corresponding image, they are called to scan the image via the “AR Tutor 4” app in order to get the information regarding the stakeholder’s perspective they are engaged with. Afterwards, students read and discuss in small groups of “experts” the perspective of the stakeholder they are engaged with. Finally, they share the stakeholders’ perspective in a shared dashboard (eg. jamboard) so as to make the corresponding information accessible to the whole group.

Hint:

The final step of Activity 3.1 is necessary in order for the whole group to get familiar with all stakeholders’ perspectives.



Activity 3.2 is led by the pre -service teachers themselves in a face -to-face, synchronous session during which the pre -service teachers work in groups. The digital media used in this activity are:

- The AR application “AR Tutor 4”:

- <https://artutor.ihu.gr/home/>



- Jamboard:

- https://jamboard.google.com/d/1y0iyetZn5Y1v4NP_2YJQ91-zJ35ADsykueuIXG343Q4/viewer?f=0

Alternative:

Activity 3.2 in order to have the format of a treasure hunt game is suggested to be carried out face-to-face. If that is not possible, the riddle part of the game can be replaced by an h5p activity hosted in the Pressbook of Climate Change scenario, under Activity 2 (<https://web.htk.tlu.ee/stem/stem2/chapter/unit-3/>). In this way pre-service teachers when they correspond correctly each riddle with the respective stakeholder an image appears which, when scanned with the AR tutor app, provides them with the information regarding the stakeholder’s perspective.

Activity 3.3

In the third and last activity of Unit 3 pre-service teachers are divided in new groups (one representative per stakeholder) in order to discuss and formulate a recommendation regarding the lignite-fired power plants shut down. Pre-service teachers reflect on the factors they take into consideration in order to develop their recommendations while they are also called to develop their counter arguments. Throughout this activity they are guided by a digital worksheet. The groups compare their recommendations and participate in the debate.



Activity 3.3 is led by the instructor in a face-to-face, synchronous session during which the pre-service teachers work in groups. The only digital media used in this activity is a shared document:

- <https://docs.google.com/document/d/1gzsBvj6Cy0WajX7EhwU9WcI5FMmInxjF/edit?usp=sharing&oid=104008878054060366347&rtpof=true&sd=true>

Hint:

We suggest a face-to-face implementation of Activity 3.3 because it is a highly demanding activity from a management point of view. Pre-service teachers need guidance regarding the procedure of the activity. Moreover, it is important for the instructor to guide the discussion during the debate and the construction of pre-service teachers' arguments and recommendations.



Co-funded by the
Erasmus+ Programme
of the European Union



Grant Agreement No 2020-1-EL01-KA226-HE-094691

For more information, please follow the link: <https://stemdigitalis-project.eu/>