SUMMARY OF ENVIRONMENTAL EDUCATION AND CLIMATE CHANGE E-CURRICULUM

Not even one country has not observed the impacts of climate change — each and every country has been observing the negative effects of climate change in many sectors. The EU clearly suggests that effective environmental education is essential in fighting climate change and solving environmental problems. Unless effective environmental education is provided to all segments of society, environmental issues will continue to be the most crucial problems of the 21st century.

This study under the LeMoon project aims to develop an e-curriculum of environmental education for secondary school students and teachers to help them understand the ecological balance and their roles in this balance. It also aims to help individuals gain sustainable perspectives on proper environmental management and the necessary skills to be active GLOBAL CITIZENS and participants with higher concerns for environmental issues

ENVIRONMENTAL EDUCATION AND CLIMATE CHANGE E-CURRICULUM (further e-Curriculum)

1. METHODOLOGY FOR THE E-CURRICULUM:

The e-curriculum is based on a modular approach. The learning units – the modules –are organised into meaningful chunks. Although the content and objectives are determined separately for each module and do not follow a linear sequence, the knowledge and skills gained before are complementary. These modules are accessible through a user-friendly online platform.

The four basic elements of the e-Curriculum are suggested to be included in each module: (1) Objectives, (2) Teaching/learning content, (3) Suggested teaching process, and (4) Evaluation

As today's learning is not imagined without the use of technology, it is recommended that e-curriculum includes:

1. Core content: environmental concepts, climate change science terminology, core environmental problems and sustainable development and good practices.

2. Multimedia Resources: videos, animations, and infographics to enhance engagement and understanding of complex environmental issues.

3. In-class or virtual activities: Virtual Labs, (Virtual) Field Trips, Case Studies, Guest Lectures, Project-Based Learning, Personalised Learning.

4. Interaction questions for deeper knowledge. Discussion Forums or topics for online/in-class discussions

5. Self-Assessment Quizzes or Templates for Knowledge Evaluation

6. Arts and creative design

2. E-CURRICULUM OBJECTIVES

It is recommended that each module has its aim. Each part of the module has its specific objectives. It is recommended to address the development of the following key competencies while designing each module:

1. Communication in foreign languages competency. It is based on the ability to understand, express and interpret feelings, thoughts, concepts, facts and opinions orally and in writing in various appropriate social and cultural contexts. Content and Language Integrated Learning (further CLIL) refers to teaching subjects such as science, history and geography to students through a foreign language. In that approach, the foreign language is used to learn a nonlanguage subject, and both language and the subject have a joint role.

2. Mathematical competency and basic competencies in science/technology: Mathematical competency means developing a mathematical way of thinking to solve a series of problems encountered in everyday life. It includes the skills and desires to use mathematical modes of thinking (logical and spatial thinking) and presentation (formulas, models, fiction, graphs, and tables) to varying degrees. STEAM is an approach that uses Science, Technology, Engineering, the Arts and Mathematics as access points for guiding students' inquiry, dialogue, and critical thinking.

3. Digital competency covers the safe and critical use of information and communication technologies for work, daily life and communication. This competency includes access to information and evaluation of knowledge, using technologies for information storage, production, presentation and exchange in public networks and communication via the Internet.

4. Learning to learn competency covers pursuing learning and the ability to insist on it for learners to organize their own learning actions individually or as a group, including effective time and knowledge management.

5. Social and citizenship-related competencies include personal, interpersonal and intercultural competencies that allow individuals to participate effectively and constructively in society and working life and equip individuals with features that will resolve conflicts when necessary.

6. Initiative and entrepreneurship competencies refer to the individual's ability to transform his thoughts into action. They include creativity, innovation, risk-taking, and the ability to plan and manage projects to achieve goals. They also include being aware of ethical values and supporting good governance.

7. Cultural awareness and expression competencies. Various media resources are used in the e-Curriculum, including music, performing arts, literature, and visual arts. It is an appreciation of the importance of creatively expressing opinions, experiences and feelings.

In addition to the above mentioned, the e-Curriculum aims to promote students' systems–thinking, anticipatory (future thinking), normative, strategic, interpersonal, collaboration, critical thinking, self-awareness, and integrated problem-solving competencies.

Each module in the e-Curiculum has its specific objectives. After implementation of the activities in the modules, students will be able to:

- develop a positive attitude towards the events occurring in nature;

- comprehend that each person leaves a positive or negative mark around them;

- establish a relationship between the use of natural resources and production and consumption activities;

- use scientific process skills and life skills in the process of discovering nature and understanding the relationship between human and the environment;

- gain awareness of sustainable development and to believe in the necessity of leaving a livable environment to future generations;

- comprehend the importance of efficient use of resources and sustainability with a local, national and global perspective on environmental problems and climate change;

- have knowledge about environmental issues and the effects of global climate change on the environment, society and economy;

- receive responsibility to prevent and mitigate the problems posed by climate change;

- gain awareness about the institutions and organisations, national /international agreements studying climate change;

- have knowledge about environmentally friendly technologies;

- to create career awareness and to get to know the relevant professional fields related to the environment.

- creative thinking and collaborative teamwork

This e-Curriculum design is based on the Competency-Based Approach; the objectives are structured gradually and sequentially according to the principle of graduality and sequentiality, from simple to complex, from easy to difficult, and from concrete to abstract. Teaching principles such as relevance, openness, and vitality were applied while aiming at module objectives.

Bloom's taxonomy was referred to when formulating module objectives. The objectives were written to require different cognitive level activities, from the most superficial level (remembering information) to the highest one (creation).

Accordingly, the e-Curriculum aims at four different levels. Level I is a knowledge level, providing receivers with knowledge of ecological concepts that can help them make ecologically sound environmental decisions. Level II is also at a knowledge level, focusing on understanding and awareness concerning many aspects of human environmental behaviour. Level III is at a cognitive process or skills level, focusing on those skills needed for issue investigation, evaluation, and value clarification. Level IV is also a process or skills level, focusing on those processes important to citizenship action (participation).

The objectives indicate the fundamental learning in the module. As recommended by the field experts of the LeMOON project research, the e-curriculum has six modules, each containing 4-8 objectives. Module topics are also the result of qualitative research (document analysis, focus groups, and expert interviews). They are presented in the following chapter.

3. E-CURRICULUM: MODULES, AIMS AND EXPECTED LEARNING OUTCOMES

Module 1 – Human and Nature

This module aims to help students observe nature, discover its delicate balance, and guide students to develop a positive attitude towards preserving natural balance by recognising the interaction between humans and nature and the roles of living and inanimate beings in this interaction.

Recommended Duration: 12 hours

Topic/Concepts: nature, living and inanimate beings, natural equilibrium/ balance

Module 2 – Cyclical Nature

This module aims to help students classify natural resources, notice the flow of matter and energy in nature through the cycles of matter and energy, and guide students to comprehend the effect of this flow on natural life and living things.

Recommended Duration: 12 lessons.

Topic/Concepts: natural resources, material cycles, energy flow.

Module 3 – Nature And Climate Change

This module aims to introduce students to climate change, including the greenhouse effect and global warming as causes of climate change. While studying the greenhouse effect and global warming, students are expected to make meaningful combinations with consumption and other reasons and to study pollution and some other environmental problems as well.

Recommended Duration: 12 lessons

Topic/Concepts: Greenhouse Gases & Emission Sources; Radiative Forcing; Earth's Atmosphere; Radiation Balance; The (Runaway) Greenhouse Effect; Difference between Weather and Climate, ecological footprint

Module 4 – The Impacts Of The Environmental Problems And Climate Change (Part 1 – Ecosystems)

This module aims to study ecosystems and guide students to discuss human impact, environmental problems, and climate change within the context of ecosystems.

Recommended Duration: 12 lessons

Topic/Concepts: Ecosystems.

Module 5 – The Impacts Of The Environmental Problems And Climate Change (Part 2 – Climatic And Environmental Challenges)

This module aims to explore some of the challenges and implications associated with climate change and environmental issues. It complements Module 4, which focuses on ecological impacts and guide students to analyse and examine the impact of climate change in its social, cultural and economic aspects.

Recommended Duration: 12 lessons

Topic/Concepts: Climatic and Environmental Challenges

Module 6 – Sustainable Development And Solutions To Environmental Problems And Climate Change

This module aims to study and explore sustainable development and guide students to solutions to environmental problems and climate change.

Recommended Duration: 12 lessons

Topic/Concepts: Sustainable development and solutions to environmental problems and climate change.

4. E-CURRICULUM STRUCTURE AND TOPICS

The e-Curriculum has six modules, each comprising six parts containing one or two lessons. Its contents are determined holistically and by the specific learning objectives for Cognitive, Affective, and Psychomotor development.

The structure of 6 modules and their parts are as follows:

Module 1 – Human And Nature

The interaction between human and nature

The effects of unplanned settlement, industrialisation, transportation and other actions.

The positive and negative effects of nature on human beings. The natural and artificial environments.

The roles of producers and consumers in the natural balance

Maintaining the natural balance (Social awareness-raising projects)

The environmental ethics and dilemmas/Case studies on ethics and dilemmas.

Module 2 – Cyclical Nature

Naming various natural resources within their qualifications

Grouping the natural resources on Earth

Sustainability and responsible use of natural resources

The difference between the matter cycle and the energy flow in an ecosystem

Ultimate source of energy and the form of energy while leaving the ecosystem.

The effects of exploitation of natural resources.

Module 3 – Nature And Climate Change

Ecological footprint.

Greenhouse gases

Greenhouse effects.

The differences between weather and climate.

Climate systems.

Climate Change vs. Climate Variability

Module 4 – The Impacts Of The Environmental Problems And Climate Change (Part 1 – Ecosystems)

Ecosystem complexity.

Aquatic /marine ecosystems.

Terrestrial ecosystems.

Freshwater ecosystems.

Ecosystem services.

Human impact on the ecosystem.

Module 5 – The Impacts Of The Environmental Problems And Climate Change (Part 2 – Climatic And Environmental Challenges)

Economic Consequences.

Displacement and Migration.

Health Risks.

Global Implications.

Environmental Injustice

Cultural and Educational Disruption

Module 6 – Sustainable Development and Solutions To Environmental Problems and Climate Change

Sustainable Development.

Stewardship and Restoration of Ecosystems

Mitigation and Adaptation Strategies

Renewable Energy and Technological Innovations

Policy and Governance

Global citizenship, policy learning, lifestyle choices, and consumer behaviour

5. E-CURRICULUM: TEACHING PROCESSES

The e-curriculum is designed based on constructivism, connectivism, and progressive education principles. These approaches oppose rigid understanding of the discipline in educational settings, are based on an active learning approach, consider individual differences, and focus on learning by reflection, active participation and collaboration. This curriculum includes student-centred methods, techniques, and teaching methods, which follow the idea of reaching sustainable development goals

in cooperation. Thus, many activities are designed for pair and group work, including discussion questions and project-based work. Some activities are taken individually, though.

Each module lesson should use a 5E learning cycle and instructional model: Engage, Explore, Explain, Elaborate, and Evaluate (Bybee, 1997) or its adaptations (such as Engage, Explore, Explain, Extend, and Evaluate; see VanTassel, 2024). This model is usually used in inquiry-based short online courses and science online teaching and requires active student participation.

6. E-CURRICULUM: EVALUATION PART

An approach using continuous and multiple assessment tools has been adopted. Continuous evaluation and general developmental and outcome-related assessment are essential in this approach.

Each e-Curriculum module has its specific objectives, which are followed by the recommended learning content. The achievement of these objectives may be evaluated by the teacher selecting and adapting recommended resources or other preferred methods. Projects, presentations, e-portfolios, reflective journals and performance evaluation scales are the main assessment methods suggested for use; however, teachers may adapt them to their needs, according to the subject and student age. In addition, practical seminars, poster presentations, interviews, debates, case studies, concept maps, and other assessment methods and tools may be used.

Evaluation Criteria: Students are recommended to be assessed on their understanding of environmental concepts, critical thinking skills, communication abilities, and active participation in class activities and collaboration in projects. Tests are not recommended to be used for student evaluation, but rather as a self-check option on the progress or understanding.

That e-curriculum has been designed for the Environmental Education and Climate Change for high school students (more focusing on students of 15 year old). Each module objective has been studied in one or two lessons, comprising 12 hours of learning content for each module (6 modules contain approximately 72 hours of learning content). The e-curriculum suggests to be taken as a stand-alone obligatory/ optional course of 6 modules, which can be either taken 4 hours per week as a one-term course or taken 2 hours per week as a two-term course. Also, by each module are art-based lessons and week-long workshops with inclusive approach for comprehensive experience on the nexus of art, science, policy.

CONCLUSION AND DISCUSSION

The Czech Republic's largely coniferous forests face the worst bark beetle infestation. The lower house of Parliament has discussed emergency and long-term measures to combat the voracious insect that kills spruce trees. The amount of spruce wood damaged by bark beetles has risen steadily. Experts warn that the nation's forests could be wiped out unless some actions are taken. For the Czech Republic, the problem is the forests getting smaller, and for some other countries, it is the ice getting thinner, but the fact is whatever the problem, 'a storm is brewing' for all of us.

EU suggests that effective environmental education is essential in fighting climate change and solving environmental problems. Unless effective environmental education is provided to all segments of society, environmental issues will continue to be the most crucial problems of the 21st century, specifically for those at risk of being unable to rebuild their lives after environmental disasters due to poor conditions. Despite the need for that education, a great majority of schools include

environmentally related topics in some subjects, and a minority have stand-alone lessons on environmental studies.

Le_MOON Project aims to develop an online environmental education for all individuals to understand the ecological balance and their roles in this balance. It also aims to help individuals gain sustainable perspectives on correct environmental management and the necessary skills to be active participants who report higher levels of concern for environmental issues.

Le_MOON Project partners designed this education programme (Environmental Education and Climate Change e-Curriculum) focusing on the 21st-century must-acquire skills, such as life and professional skills, learning and innovation skills and information media and digital/technology skills in a lifelong learning perspective.

Le_MOON project follows the principle "engage – understand – act" and recognises the need for collaboration of pupils, parents, and the broader community to make changes and become climate neutral by 2050. Recognising the need for an efficient education that may engage and foster action, the e-curriculum has been designed to inspire teachers to use the developed resources aiming at a better future.

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