CITIZEN SCIENCE & ENVIRONMENTAL EDUCATION FOR SUSTAINABILITY

ONLINE
TRAINING
COURSE

Environmental
Education
Lab

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NKUA

Module 3

THE EUROPEAN COS4CLOUD PROJECT:
APPROACHING THE CHALLENGE OF OPEN SCIENCE FROM A CITIZEN SCIENCE PERSPECTIVE

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Contents

In this module...

The third module of the Training Course presents the European Cos4Cloud project within the context of which this training course is implemented. Specifically, an analysis is made of the concept of ''Open Science'' as a philosophy and vehicle for democratizing and streamlining scientific research, focusing also on the place and role of Citizen Science (CS) in this effort. The European Cos4Cloud project is presented in relation to how it attempts to respond to the challenge of Open Science. The project's vision is described, its objectives and main lines of action are listed and the importance of integrating the various Citizens Observatories and developing new relevant CS services in the European Open Science Cloud (EOSC) is highlighted. The project is also portrayed in relation to the partners and Citizen Observatories participating in its implementation and a brief presentation is made of the special role played in it by the Environmental Education Lab (EEL, NKUA).

All the above are approached in Module 3 as answers to the following **questions**:

- ✓ What is the concept of ''Open Science''?
- ✓ What is the relationship of Citizen Science with Open Science?
- ✓ What are the vision, objectives and lines of action of the European Cos4Cloud project?
- ✓ Who are the contributors of the Cos4Cloud project?
- ✓ Which Citizens Observatories are participating in the Cos4Cloud project?
- ✓ What are the fields of action and initiatives promoted by the Environmental Education Lab (NKUA) through the Cos4Cloud project?
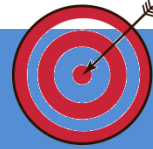
Expected Learning Outcomes – Goals

Upon completion of Module 3 you should be able to:

- ✓ define the concept of *Open Science* in the context of the corresponding policy promoted by the European Commission
- ✓ recognize the *relationship* between *Citizen Science* and the Open Science concept and policy
- ✓ describe the *vision*, *objectives* and *lines of action* of the European *Cos4Cloud* project
- ✓ name the *contributors/partners and Citizen Observatories* participating in the implementation of the **Cos4Cloud** project
- ✓ describe the *fields of action* and *initiatives* promoted by the *Environmental Education Laboratory (NKUA)* in the *Cos4Cloud* project

Keywords

- European Cos4Cloud project
- Open Science
- European Open Science Cloud (EOSC)
- FAIR Data initiative
- Integration of Citizen Observatories
- Environmental Education Lab (EEL/NKUA)

3. The European COS4CLOUD project: Approaching the challenge of Open Science from a Citizen Science perspective

3.1 What is the concept of ''Open Science''?

One of the dimensions that Citizen Science (CS) has been linked to in the 21st Century is that of ''**Open Science''**, otherwise known as **''Science 2.0''**. According to the European Union (2016) the concept of ''Open Science'' comes in response to the **request for the creation of a dynamic democratic environment for organizing, conducting and making publicly available scientific research**, which gives access to all stakeholders and anyone else who might be interested, to the data, processes and results of each individual research project or the totality of research in the various scientific fields.

Under the auspices of ''Open Science'' the goal is **to make the whole cycle of scientific research ''open'',** from the conception of a research idea, up to the announcement of the research results. Supported by the **new digital technologies and tools,** a new environment is created that strengthens and facilitates interaction between researchers and the continuous sharing of scientific knowledge. Access to publications and research data, all of which in digital form, is free with no, or minimal restrictions (**''Open Access''**). Also becoming freely accessible are the funding mechanisms (e.g. through crowdsourcing platforms), electronic databases (e.g. with data repositories, digital libraries, etc.), and open peer review systems etc. And so the established practices of publishing research results after completion of the research process are inevitably being abandoned.

The creation of the **European Open Science Cloud** and the promotion of the **FAIR Data**. Initiative are among the **eight priorities** of the EUA Open Science Agenda

The **European Open Science Cloud, EOSC** is an ambitious project of the European Commission, that aims to promote international recognition and maintain the leadership role of science conducted in the European space through the creation of a reliable digital environment for hosting and processing research data and results. This goal will be achieved by developing a world-class scientific infrastructure from which European scientists and other stakeholders will reap the benefits of science in the digital economy and wider community.

The ''Cloud'' will offer 1.7 million European researchers and 70 million professionals in science and technology **a virtual environment** with open and seamless **services** for storing, managing, analysing and reusing research data, in distinct scientific domains and interdisciplinary fields. All these services will be free.

Image 1: The Logotype of the European Open Science Cloud

The **FAIR Data** (**F**indable, **A**ccessible, **I**nteroperable and **R**eusable Data) initiative is a bottom-up approach, that aims to implement the **principles** making data **findable, accessible, interoperable** and **reusable.** It offers an open and inclusive ''**ecosystem''** for individuals, institutions and organisations working together through Implementation Networks - INs. The INS are active in three activity pillars: GO CHANGE, GO TRAIN, and (GO BUILD).
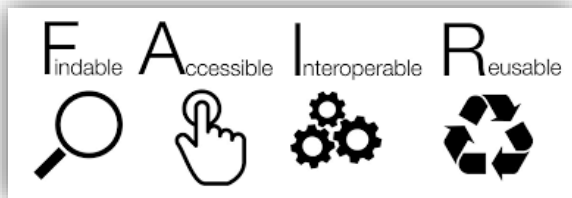
Image 2: The logotype of the FAIR Data initiative

3.2 What is the relationship of Citizen Science with Open Science?

Together with the creation of the European Open Science Cloud and the FAIR Data Initiative, **Citizen Science** (CS) is also **one of the eight priorities of the EUA Open Science Agenda**. Over the last few decades, CS' contribution to scientific research has escalated, thanks to the use of digital technologies. Millions of data are collected worldwide every year through the **Citizen Observatories** (COs), thus contributing not only to research but also to policy-making. (Bio Innovation Service, 2018).

The concept of ''Open Science'' finds special grounds in the attempt to reshape the prevailing culture surrounding scientific research, which either does not recognize, or considers of secondary importance, any other ways of producing knowledge other than that of traditional science - and the same applies also to the general public's engagement in it. However, as noted in the announcement of the 3rd UNESCO Environment Conference (UN Environment Assembly, 2019): 'Traditional science cannot provide all the information on its own, nor at the required level for understanding environmental changes''. Conversely, CS offers many distinct advantages, such as the fact that it encompasses different types of knowledge and promotes collaborative intelligence and co-creation in finding community-based scientific solutions. In addition it attempts to create connections between science and education, which

when combined with new and emerging technologies overcome the geographical, thematic or even linguistic ''boundaries'' to doing scientific research and the public's engagement therein. Finally, the recent development of CS has given rise to a variety of approaches, tools, sources, programmes and achievements in all scientific domains, the experience of which can be used to the advantage of scientific research and knowledge.

This exponential increase in participants, data and research output from the CS area accounts for more than 50% of the data available on the **Global Biodiversity Information Facility** – (GBIF) and has generated a significant number of observations relating to environmental monitoring (for the air, water, noise, odours, climate, etc.). All the above pose many, large-scale challenges for the COs, which will need to facilitate not only efficient data capture, identification and validation, but also the interaction among all parties involved in the CS processes, based on a model that allows for the transfer of knowledge, as well as stewardship and storage of large volumes of data in different formats.

The COs also have to ensure **interoperability** among themselves at a local, national and global level, as well as their **sustainability**, overcoming any difficulties in accessing data by developing new functions using cutting-edge technologies. Hence, the recommendations of the European Commission on Open Science (European Commission, 2018) emphasise the **development of infrastructure**, **formulation of guidelines and specifications** and need for **providing central networks**, that will highlight and promote citizens' initiatives. They will also provide opportunities for collaboration, shared use of tools and exchange of best practices (Bio Innovation Service, 2018).

3.3 What are the vision, objectives and lines of action of the European Cos4Cloud project?

As already mentioned in the previous subsection, together with the creation of the European Open Science Cloud, and the FAIR Data Initiative, CS is one of the eight priorities of the EUA Open Science Agenda (European Commission, 2018). It is within this same context that the European **Cos4Cloud project** (full title: **"Co-designed Citizen Observatories Services for the EOS-Cloud"**) attempts to act and respond. This is a research and development project (R&D) that was submitted as a proposal, evaluated and approved for co-financing, by the European Union's **Horizon 2020** Programme.

The 40-month Cos4Cloud project started in November 2019 and will finish in February 2023. Its main goal is to **develop new services for CS' core structures, the Citizen Observatories (COs).** These services will complement, improve and upgrade the operation of the COs and will be available to both the European scientific community and to all volunteer scientists taking part in CS programmes and actions as CO users.

Image 3: The logotype of the European Cos4Cloud project

More specifically, the **vision** that the Cos4Cloud project has set and is attempting to serve is **to integrate CS into the European Open Science Cloud** by co-designing innovative services that respond to a number of challenges faced by the COs in relation to the CS services they offer to the scientific community and society. The project builds on the **digital infrastructures and services** provided by some of the existing COs in Europe and enhances them with **new, state-of-the-art services,** in an effort to strengthen the presence and role of the COs and ensure that not only are they sustainable but that their field of activities continues to expand at a global level. These new services that will be co-designed by various actors participating in the CO processes, and which will be developed and tested during the project, will appear in the form of a ''menu'' of functions so that each new or existing CO can select and install the ones it needs.

The **objectives** of the Cos4Cloud project are to:

1. *Integrate Citizen Science into the European Open Science Charter through the development of a ''Minimum Viable Ecosystem'' for the Citizen Observatories and to integrate it into the European Open Science Cloud hub.*

2. *Co-design, prototype and implement innovative services for the Citizens Observatories, based on the architecture for federated structures, to help address the challenges faced by COs, focusing on interoperability and innovative models of collaboration, aimed at serving all CS stakeholders, from professional scientists and citizen scientists to government representatives, industry and entrepreneurs.*

3. *Increase the quantity and quality of the available data coming from CS following the FAIR Data Initiative principles.*

4. *Make available to the Citizens' Observatories, user-friendly horizontal services supported by and leveraging artificial intelligence, automated information extraction, recognition and visibility of data contributors, visibility of data, validation and integration using information in different fields (biodiversity, air quality, water quality).*

5. Facilitate networking and knowledge management processes across organizations, people and initiatives in the context of the COs by designing tools, access mechanisms and interfaces based on collaborative design methods, Open Science recommendations and EOSC guidelines.

Specifically, **ten new technological services**, will be designed and developed, whose **interoperability** and data **security** will be ensured. They will be based on **open specifications** and be **user-friendly**. The objective is for anyone interested to be able to reuse the data collected from different CS programmes and activities over and over again for research, innovation and educational purposes. Taking into account the scale of the partnerships supporting the various COs in different fields of research, the designed services may end up serving several thousands of their users, not only in a pan-European community, but stretching also to a global, scientific albeit non-academic one.

One of the services to be designed is a **portal** integrating all the observations and data collected from the different science-related COs and citizen science platforms focused on **biodiversity** and **environmental monitoring**. Other services will include a series of **artificial intelligence tools** that will help citizens recognize, for example flora and fauna species when they observe or send an observation of them, thanks to confirmation through the corresponding data collected from different platforms or recorded in the relevant data bases. This service is already being used on CS platforms and related projects. A case in hand is Pl@ntNet, which is also one of the partners and COs in the project. As explained by Alexis Joly, researcher at INRIA and member of Pl@ntNet's design team, ''in the Cos4Cloud project, in addition to making this technology available to other CS projects, we want to go one step further, and suggest, through this technology, the species that one can expect to find and/or find in a certain area''.

It is also planned to improve the quality of the data and related information from CS programmes and actions by establishing a **common vocabulary**, also in the context of **machine learning**, with services encompassing automatic video recognition and creation of advanced mobile application interfaces as well as new models and protocols validated by traditional science. The new services will ensure the visibility and recognition of the input from the data contributors and improve networking between various participants – partners. In the long term, all these services will be used also by other COs and CS programmes operating in thematic areas, (other than the environment), such as health.
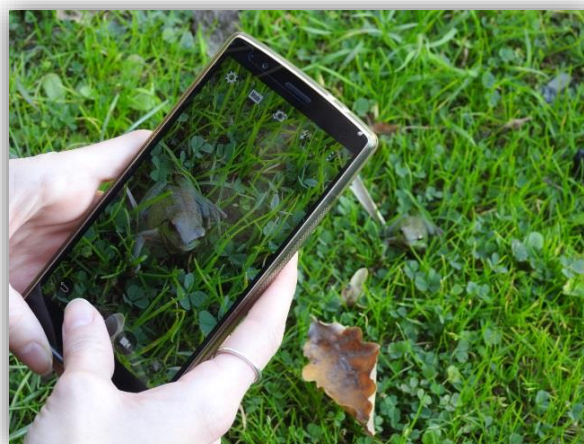

Image 4: Recording observations with the app CO Natusfera's app

Services to be developed within the context of the Cos4Cloud project

- ✓ A **portal** that **will** gather, and provide access to, observations/data from different Citizen Observatories

- ✓ Use of **artificial intelligence** for species recognition/ identification

- ✓ Facilitation of AI **knowledge by** leveraging observations from different Observatories

- ✓ Access to large-scale data bases (e.g. **Pl@ntNet**)

- ✓ **Estimate/prediction of** the presence of species **based on location**

- ✓ Facilitation of **analysis** and **visualization of citizen-sourced data** (Python-based)

- ✓ Development of user/citizen-friendly **interfaces** for data collection through sensors on smartphones

- ✓ Assistance of automated species recognition from **camera trap images**

- ✓ **Identification system** that allows citizens to find out how scientists use their observations

- ✓ **Video stream** processing service

Some anticipated positive effects of the Cos4Cloud project

1. Open Science goals supported through improved access to content and resources and facilitation of interdisciplinary collaborations

2. Enhanced position of CS in the scientific community

3. Improved citizen science ecosystems; increased quantity and quality of available citizen science data

4. Stable, reliable, user-oriented environment for citizen-scientist volunteers

5. Monitoring of access to, and reuse of, data in research, industry and governance

3.4 Who are the contributors of the Cos4Cloud project?

The COs4Cloud project is implemented by a team of collaborating agencies with considerable experience in CS actions and who have led large-scale projects in this sector. More specifically, the project team consists of **16 Partners** from **7 European countries** and **1 Latin American country**.

The project is coordinated by the **Consejo Superior de Investigaciones Cientificas (CSIC)** (Spanish National Research Council) and, in particular, by the **Institute of Marine Science (ICM)**. Spain participates in the project with 3 more official partners: research centre **CREAF** (Centre for Research on Ecology and Forestry Applications) and **IFCA-CSIC** (Institute of Physics of Cantabria - Consejo Superior de Investigaciones Científicas), the NGO **Science for Change** and developer of web technologies **Bineo Consulting**.

Universities, research centres, NGOs, agencies and companies from different European countries form an interesting mosaic, and offer rich experience and knowledge from different perspectives. Participating from the **United Kingdom** are the **Open University,** NGO **Earthwatch and app development company DynAIkon. From** *France,* **INRIA research centre** and from *Sweden* the **Swedish University of Agricultural Sciences**. From *Holland* Dutch Company **DDQ** and from *Germany,* NGO **52°North,** and the company **Secure Dimensions.** Representing Europe in the project is the **European Citizen Science Association (ECSA)** and participating for *Colombia* is NGO **Trébola.** Representing *Greece* in the official project team is the **National and Kapodistrian University of Athens** through **the Environmental Education Lab (EEL).**

An important part of the dynamics of the Cos4Cloud project lies precisely in this interdisciplinary and international collaboration, since in the implementation team experts from the field of CS, service designers, companies, researches and scientists all join forces.

Image 5: From Cos4Cloud's kick-off meeting (November 2019). Photo: Cos4Cloud's team.

3.5 Which Citizen Observatories are participating in the Cos4Cloud project?

Cos4Cloud relies on the participation of a **network of 9 Citizen Observatories** focused on **biodiversity** and **environmental monitoring**. These platforms will be responsible for **testing** the various services developed within the project, and for their **evaluation** by the end users.

The first part of the project focuses on four of the largest citizen biodiversity COs: **Natusfera,** **iSpot**, **PlantNet** and **Artportalen.** In the second part, the services developed will be tested on CO platforms focused on environmental quality. Specifically, the participating observatories are: **Freshwater Watch** and **KdUINO,** focused on water quality monitoring, **OdourCollect,** focused on odour pollution monitoring, **CanAir.io,** focused on air monitoring and **iSpex,** focused on aerosol monitoring.

Examples of 4 of the COs participating in the project are given below: biodiversity observatories **iSpot**, **Natusfera** and **PlantNet** and environmental monitoring observatory **OdourCollect.**
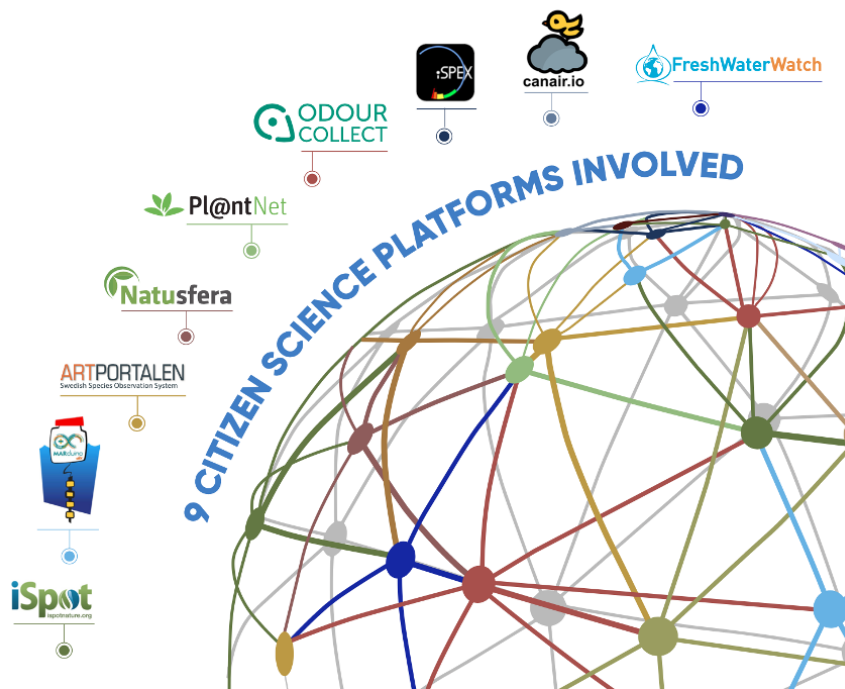

Image 6: The nine citizen observatories involved in the European Cos4Cloud project

iSPot

https://www.ispotnature.org

iSpot is one of the most well-known CO platforms on biodiversity. It encompasses a network of over 68,000 volunteers, scientists/nature observers worldwide, who have recognized and identified around 30,000 species, through over 1,500,000 images of more than 750,000 observations of different species of flora and fauna.

Anyone can join and participate in the iSPot community by sending photos of:

• birds
• amphibians and reptiles
• fish
• fungi and lichens
• invertebrates
• mammals
• other organisms
• plants

iSpot has been integrated into the teaching, including modules and courses, of the UK Open University facilitating informal and non-formal science learning, through the Open University-BBC coproductions and the free learning resources.

iSpot data is also a **research-grade tool for investigations on biodiversity**, making an important contribution to national strategy and policy in associated areas. For example, iSpot was part of a partnership initiative, funded by Defra, to define a National Pollinators Monitoring Scheme. Additionally, **the value of citizen science through tools like iSpot is explicitly mentioned in the 2011 Government White Paper** on the environment in the section on 'Reconnecting people and nature' and the OU, through iSpot, is a Royal Society for the Protection of Birds (RSPB) partner.

Language: English
Geographical coverage: international
Coordination and funding: Open University (United Kingdom), since 2009.
Website : https://www.ispotnature.org
User registration page: https://www.ispotnature.org/register

Natusfera
https://natusfera.gbif.es

Natusfera is one of the largest CO platforms in the biodiversity domain. Its main objective is to share biodiversity learning with the whole volunteer-citizen community that it has created, through their recordings of different kinds of living organisms on the relevant app. More than 13,000 citizens have participated, contributing over 240,000 observations to Natusfera.

As in iSpot, citizens can participate in Natusfera by sending photos of:
• birds
• amphibians and reptiles
• fish
• fungi and lichens
• invertebrates
• mammals
• other organisms
• plants

Natusfera is a digital space where, after registering the user can then organize and share photos of all sorts of biodiversity observations. It is a sort of 'virtual field notebook' that allows users to keep their observations in the cloud, connect and talk with other citizens/users, who can help in identifying the photographed species. It is also possible to collaborate in various projects as well as create new ones with all sorts of geographical scope (e.g. for invasive species, lichens, marine biodiversity, etc.).

Natusfera has been adopted as the CS platform for the Spanish node of the Global Biodiversity Information Facility (GBIF), which also covers its basic operating costs.

Languages: English, Spanish, Catalan, Galician, Basque, Italian
Geographical coverage: local, national, pan-European, international
Coordination and funding: Started out in June 2016. Coordinated by a consortium of organizations among which three are Cos4Cloud partners: CSIC, CREAF and Bineo.
Website: https://natusfera.gbif.es/?locale=en
User registration page: https://natusfera.gbif.es/signup

Pl@ntNet

https://plantnet.org

Pl@ntNet is a participatory CS platform for collecting, sharing and reviewing plant observations based on automated identification. Its objective is to monitor plant biodiversity and facilitate access to plant knowledge by the general public.

The platform's website and smartphone app are used by a large community of several million citizens who produce hundreds of thousands of plant observations daily. This data stream is of high interest for many research domains, including ecology, agronomy and energy.

Among other features, this free mobile app helps identify plant species from photos using visual recognition software. This means that the user can send a photo of any plant and through the app get help in identifying the species thanks to artificial intelligence. At the same time the Pl@ntNet app improves its performance with every new observation (new species, new data, higher quality, etc.).

Confirmed observations are integrated into the Global Biodiversity Information Facility (GBIF), the world's largest international repository of biodiversity. Pl@ntNet's data and mode of operation are of great interest to an increasing number of researchers and CS stakeholders in various domains (data science, ecology, biodiversity, phenology, plant health etc.).

Within a few short years Pl@ntnet has turned into a CS ''ecosystem'' with millions of registered users and tens of thousands of active users.

Languages: French, English (*smartphone app available in many other languages including Greek*)
Geographical coverage: local, national, pan-European, international
Coordination and funding: Pl@ntNet is an open consortium currently including 4 French research organizations (CIRAD, INRAE, Inria and IRD) and the Agropolis foundation
Online version of the app: https://identify.plantnet.org

OdourCollect
https://odourcollect.eu

OdourCollect is an app that any citizen can use to report incidences of environmental pollution detected and identified on the base of bad odours. It is a participatory tool to empower citizens and local communities affected by odour nuisance to report such cases to the rest of the world.

The app goals to build ''odour maps'' based on the observations of different citizens. Anyone can take part by reporting bad odours with the goal of co-creating solutions with all the stakeholders involved (citizens, industries, local authorities, experts), to improve the quality of life of a community. Odour observations can be validated by experts to gather data in a particular area, where a community is affected by this problem. The ultimate goal is co-designing local solutions with relevant stakeholders.

Any citizen can act as an observer and report geo-localized observations on some odour episode, which are open data and can be used to build collaborative odour complaint maps, report complaints and identify their emission sources. Odour pollution is the second reason for environmental complaints in the whole of Europe, after noise. Frequent and continued exposure to odours can cause headaches, stress and respiratory problems. Unusual and unpleasant smells can also be a sign of greater environmental problems, such as poor waste management or contaminated water.

OdourCollect has been implemented in 10 pilot programmes in different countries, under the European D-Noses project (Spain, Chile, Greece, Portugal, Germany, UK, Bulgaria, Italy and Uganda).

Languages: Spanish, English, Catalan, Portuguese, German, Italian,
Geographical Coverage: local, national, pan-European, international
Coordination and funding: The first version of OdourCollect was developed by Science for Change and produced within the framework of MYGEOSS, a two-year (2015-2016) EU project for developing smart Internet applications GEOSS (Global Earth Observation System of Systems), informing European citizens on the changes affecting their local environment.
Website: https://odourcollect.eu

3.6 What are the fields of action and initiatives promoted by the Environmental Education Lab (NKUA) through the Cos4Cloud project?

The **Environmental Education Lab (EEL)** (URL: http://eel.eds.uoa.gr/) belongs to the Department of Secondary Education of the Faculty of Philosophy of the National and Kapodistrian University of Athens (NKUA). It was established in 2004 (ΦΕΚ 221/τ. Β'/18.02.2005) by the Department of Philosophy, Pedagogy and Psychology as an administrative and scientific transformation of the former **Environmental Education Centre (ECE).** As an academic structure it carries out research, educational, training, developmental, advisory and social work in the subjects of Environmental Education (EE) and Education for Sustainable Development (ESD), serving the following **purposes:**

- Development of research, academic cooperation and scientific presence in the field
- Education of undergraduate and postgraduate students
- Initial and ongoing teacher training
- Environmental information and communication, raising awareness and training groups of the general public
- Scientific support of the educational project and provision of consulting services to institutions, organisations, individuals and teams
- Development of partnerships and sharing experiences with other institutions, centres, organisations and teams at a national, European and international level

- Contribution to networking and creation of communities of learning and practice between individuals, groups and organisations
- Development of printed and digital educational material in the context of formal, non-formal and lifelong learning
- Contribution to the dialogue for the formation of national and European education policy on R and D matters and development of EE and ESD.

The lab's **scientific team** consists of its Director, Mrs. **Maria Daskolia,** Asst. Professor of Environmental Education of the Department of Secondary education, other collaborating teaching and research staff of the Department, teaching and research staff of other Departments and Universities, doctors and PHD students of the Department, specialized laboratory staff as well as teachers who are specialized and have experience in EE/ESD.

To date, the EEL has coordinated or participated in the implementation of **11 European and national research projects.** The EEL participates in the European **Cos4Cloud** project as a national partner, having undertaken to plan and implement actions that will contribute to connecting CS and the COs participating in the project with the school community, in Greece and at a European level, through **Environmental Education/Education for Sustainable Development** (EE/ESD).

Within this framework, the EEL has already started, or is about to carry out, a number of actions, namely:

- ✓ **Training** the main education contributors as regards CS, utilization of the COs' structures and services and incorporating them into school practice of EE/ESD in Greece.

- ✓ **Co-creation** of relevant educational material for Primary and Secondary schools

- ✓ Collaboration with education officials and teachers for the **planning** and **implementation** of educational activities /programmes in schools

- ✓ Collaboration with **NGOs** and **Local Authorities** for the planning and implementation of actions in/with schools within the **community**

- ✓ Creation of **communities of practice** to interface with the actions, platforms and communities of the **Citizen Observatories** participating in the project

- ✓ Establishment **of school networks** at a regional, national and European level

- ✓ **Research** on learning and participation in CS educational actions in the context of state-of-the-art EE/ESD practices

These actions also include the online training course, ''**Citizen Science and Environmental Education for Sustainability**'' (https://eclass.cce.uoa.gr/courses/CCEHUMAN121/), which is implemented on the Eclass platform with the technical support of the Center for Education and Lifelong Learning (KEDIVIM) of the NKUA.

Image 7: Part of the webpage design of the Environmental Education Lab of NKUA

To sum up…

Cos4Cloud is a European project that promotes and facilitates the integration of the Citizen Observatories within the context of the European Open Science Cloud (EOSC). During the project (2019-2023) a series of activities will be carried out aimed at coordinating CS tools and actions and which will ensure the existence of a data cloud, within the context of a stable, reliable and manageable packet of storage services, analysis tools and platforms available through the EOSC hub. The project is supported by a network of nine COs. The various services that will be developed during the project will be tested through the COs' platforms. Participating in the project are a number of agencies from Europe and Latin America, who have considerable experience in CS actions. Among them, the EEL, as the national partner will design and implement actions that will connect CS with the school community and, in particular, with Environmental Education/Education for Sustainable Development (EE/ESD).

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