

PARADIGM Tools to Enhance Internet of Things and STEM in Environmental Education

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The active role of citizens and their direct involvement is essential to address climate change. Changes in citizens' and consumers' behaviours towards more sustainable patterns can be boosted through education, awareness-raising, citizen science, observation, and monitoring their environmental impacts. It is essential to involve citizens directly, and especially the young generation and communities in contributing to taking action for the climate and in protecting the environment, thereby encouraging them to change their behaviour and mindsets, reduce their carbon and environmental footprint at the individual and collective levels. These actions would lead to a more sustainable lifestyle and relationship to the environment.

PARADIGM tools aim to use the appropriate technological infrastructure (ESP32 Arduino boards with sensors) to empower the active engagement of citizens in taking action against climate change and for sustainable development through better monitoring and observing the environment and its environmental impacts, such as air quality and energy consumption.

**DERIO, BASQUE COUNTRY,
SPAIN, PORTUGAL, GREECE,
CYPRUS**

Geographical area

Derio, Basque Country, Spain

Also: Portugal, Greece, Cyprus

Period of implementation

Started 1 February 2023.

Scope of the practice

This practice can be implemented in Initial Vocational Education and Training (IVET) and/or Higher Vocational Education and Training.

Educational level

EQF levels 3, 4, and 5.

Introduction and context

Stakeholders:

- Politeknika Ikastegia Txorierrri (High School for Science and Technology and Vocational Education and Training): www.txorierrri.net
- The Cluster of Schools named AGRUPAMENTO DE ESCOLAS JOSÉ ESTÊVÃO: www.aeje.pt
- The Electromechanical School Varaždin: <https://ess.hr/eng/>
- IDEC is a training consulting company: <https://idec.gr/>
- Hellenic Open University (HOU) (distance learning): <https://www.eap.gr>
- The Emphasys Centre (Education, ICT Training Centre, Research and Software Development Centre): <https://emphasyscentre.com/>

Drivers and Objectives

In order to involve citizens' and consumers in actions and encourage behaviours to affect a more sustainable lifestyle, there is a need for activities in the field of raising awareness of students and citizens on the importance of preserving the environment. Through the latter, the students will acquire new, additional competencies that will make them competitive in the labour market. In addition, there is also a need for upskilling the teaching staff through novel educational methodologies and promotion of STEM oriented activities in schools, VET providers, and universities that can lead to innovative curricula, development of competences in the green sector, and make teachers and students levers of change. Bringing awareness to environmental issues through STEM (Science, Technology, Engineering and Mathematics) and STEAM (Science, Technology, Engineering, Arts and mathematics) has attracted a lot of interest lately due to the increased availability of commodity low-cost open-source hardware and software solutions, as well as due to the increased interest of young students in being engaged in such activities.

Additionally, latest technological advances in the fields of wireless sensor networks and the so-called Internet of Things (IoT) have introduced unprecedented capabilities towards monitoring and controlling the environment even at a personal level and in every aspect of everyday life. Turning these technological tools into powerful educational tools coupled with their proper societal dimension is the opportunity foreseen by the PARADIGM materials. Based on the above, PARADIGM is a structured pedagogical, scientific, and educational project. It contributes to the needs identified above through involving citizens directly and especially the young generation and communities, in action plans that would lead to a more sustainable lifestyle and relationship to the environment.

Target Groups:

Teachers and Students (directly), and European Schools (indirectly).

Funding:

The project is co-funded by the European Union

Key activities and outcomes

PARADIGM tools aim to use the appropriate technological infrastructure (devices, data platforms, and tools) to empower the active engagement of citizens in taking action against climate change and for sustainable development through better monitoring and observing the environment and its environmental impacts.

The materials are accompanied by appropriate video tutorials and guides to help teachers introduce IoT-STEM teaching methodologies and guide them through the process of setting up and programming Arduino kits with sensors to take different measurements (air quality, energy consumption, quality of water etc). More specifically, the e-learning course for teachers on environmental awareness consists of the following modules:

1. Strategies to raise environmental awareness;
2. Pedagogical methodology;
3. Environmental challenges (+ 15 developed learning scenarios);
4. Environmental observatories (+ video tutorials and guides);
5. Turning youth to digital scientific changemakers;

All learning materials are accompanied by learning scenarios for teachers with challenges to empower the active citizenship of students.

PARADIGM materials have been tested in several European countries (Spain, Portugal, Greece, and Cyprus) and by over 20 schools, universities, and VET providers. Both teachers and students have learnt how to set up an ESP32 board using Arduino programming with different sensors, and have also learnt how to transfer this data to an open online software of data visualization to measure several environmental impacts. The IoT observatories have also been used to set alarms when a specific measurement is over the estimated parameters. All this has been carried out through challenge-based learning and with different teams of teachers and students.

The feedback has been very positive as students can take real measurements and evaluate real environmental impacts of their everyday activity or day everyday school/VET centre activity, while at the same time acquiring IoT and programming/technical skills which might not feature in their specific fields of study, contributing to better prepared future workers and the upskilling of teachers and trainers.

Other information

Students participating in the challenge-based learning scenarios IoT observatories and measuring of data have also taken part in a European contest where a Portuguese VET centre was awarded with a 3D printer.



SOURCES

<https://paradigmproject.eu/>