

$$\frac{\partial p}{\partial t} + \frac{\partial}{\partial x}(e u) = 0$$

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} = -\frac{1}{e} \frac{\partial p}{\partial x}$$

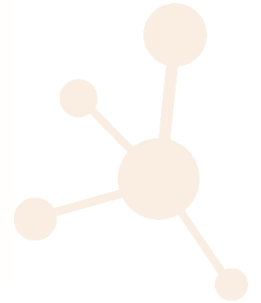
$$\frac{\partial}{\partial t} \left(\frac{p}{e} \right) + u \frac{\partial}{\partial x} \left(\frac{p}{e} \right)$$

State of the art analysis of existing initiatives, best practices and attitudes towards STE(A)M in educational contexts

D2.4 Reflective Practice Case-study Compendium



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



Increasing Young People’s Motivation to Choose STEM Careers Through an Innovative Cross-Disciplinary STE(A)M Approach to Education

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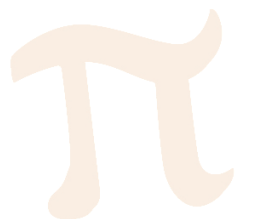
WP2 - State of the art analysis of existing initiatives, best practices and attitudes towards STE(A)M in educational contexts

D2.4 Reflective Practice Case-study Compendium



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Introduction

The following Compendium of best-practices was designed by the work package leader [EUROTraining](#) – Greece under the guidance of the project coordinator [CESIE](#) – Italy, with support from project partner [Lifelong Learning Platform](#) – Belgium. It was developed with the contributions of all the core project partners including [GrantXpert](#) – Cyprus; and [Blue Room Innovation](#) – Spain.

This document is a collection of case-studies discussed during the reflective groups by the three key stakeholder groups: representatives from businesses, HEI and local authorities, conducted in all implementing partner countries. It functions as an add-on to the ***State-of-the-Art Study***. The compendium describes:

- measures and practices adopted or proposed by the selected businesses and academic institutions to increase motivation among young people, especially women, to undertake STEM careers,
- success stories related to cross-sectoral cooperation with the involvement of businesses, HEIs, policy-makers and school systems,
- existing measures and case-studies demonstrating successful modes to increase young people's interest in STEM subjects, especially those related to practical use of STEM knowledge to address real-life problems,
- measures adopted by the involved companies, HEIs and local authorities to open access for both female and male students to their field of action to address gender segregation in the STEM field

The compendium collects the results of an in-depth reflection on existing measures, best practices and needs from the academic and business world, as well as on the policy level, thus providing a lever to align the new action proposed by CHOICE to existing initiatives.

Methodology

All core partners implemented one or two reflective groups involving overall 6 people per country. The results were initially included in the national *Reflective Group National reports*. The national reports were developed under the guidelines and templates provided by EUROTraining, under the guidance of CESIE and they were finalized after the review of all project partners. The template that was followed can be found in [Annex I](#).

The reflective groups aimed to identify a set of issues at university, labour-market and policy level demonstrating the necessity of adopting a STE(A)M approach to STEM education since school, and positive measures adopted as well as initiatives and policies in place within their working context promoting STEM education (with a STE(A)M approach).

The procedure was based on non-formal and participatory approaches, e.g. reflective practice techniques able to boost reflection on specific issues and activate a learning process, group discussions to undertake deeper reflection, sharing reflections with others, consider further improvements.

The participants for each project partner implementing the reflective groups were:

- **2 managers from companies in the STEM field**
Representatives from companies in the STEM field, who will provide inputs about needs, issues and approaches of STEM in real-world applications. Role models from the business world, who have chosen a STEM career and can provide first-hand testimony of real-life-applications.
- **2 representatives from Higher Education Institutions (HEIs)**
Professors, PhD, etc. from the STEM field, who will provide inputs about needs, issues and approaches of STEM in real-world applications. Role models from academia, who have chosen a STEM career and can provide first-hand testimony of real-life-applications.
- **2 representatives from local authorities**
Government Ministries, Administrative bodies, departments, National Chambers of Commerce and Industry, etc.

Collection of Case-studies

Italy

POLIWO Project



The main aim of the project is to increase the access to female students in the engineering faculties, due to the low percentage of female students registered in these faculties, compared to male students. The project has an important focus on gender issues: the *"We are HERE"* awareness raising campaign was organized to dispel gender stereotypes by telling the experiences of female students and researchers.

- **Type of initiative:** project and awareness raising campaign
- **Organization of the initiative:** Polytechnic University of Turin
- **Type of organization:** the project was coordinated by Higher Education Institutions

- **Funded by:** Polytechnic University of Turin
- **Lessons learnt:** many female students who participated in the project said that they were more confident, that they had overcome their limits and gave their contribution to fight gender stereotypes within the university environment.
- **History, Goals and Key Aspects:** The project was launched with the goals of fighting gender stereotypes in the engineering world through events, news and stories of the women who made science and, above all, the women who will make it. *"We are HERE"* is the interactive campaign with which the Polytechnic of Turin has decided to put itself at stake on Equal Opportunities and on the inclusion of female figures in STEM (Science, Technology, Engineering and Mathematics). Girls interested in science need points of reference, and one of the fundamental problems for young future engineers is the absence of concrete and achievable models that can fulfil their imagined expectations: the goal of the project is to create this model as well as points of reference for young female students.

Art, Origami and Mathematics Project (*Progetto Arte, Origami e Matematica*)

The project involved students from 5 to 17 years old and aims at promoting STEAM approaches in education of mathematics, with the inclusion of art. Students have to choose a painting during the lesson, and for each painting, 3 or 4 elements are covered with origami models. Each origami model is combined with a specific math lesson: topics are suitable for the class (from primary school to high school). For high school students, each model has technological application.

- **Type of initiative:** Project

- **Organization of the initiative:** Polytechnic University of Turin
- **Type of organization:** The project was coordinated by Higher Education Institutions
- **Funded by:** The project was partly funded by the school (materials) and partly by my own research funds (travel).
- **Lessons learnt:** mathematical logic, problem solving with trigonometry, continuous and derivable, integral functions
- **History, Goals and Key Aspects:** The goal of this initiative is to integrate art in the teaching of STEM disciplines. Playing with origami means exploring shapes and structures and it is the best introduction to the geometry of space. It also stimulates intuition and creativity, so it is definitely mathematics. The technique of folding paper (from Japanese "origami") is used in this way to explain and visualize algebraic concepts such as exponentiation and their sums or standard identities. This tool is therefore suitable for inclusive and innovative didactics that takes up the concepts of "learning by doing" and "visual learning".

[In2Steam - Inspiring Next Generation of Girls through Inclusive STE\(A\)M Learning in Primary Education](#)

In2Steam is a three-year-long project aiming to support the competence development of teachers and educators in teaching and transferring the STE(A)M concepts to young children at primary schools. The action mainly focuses on girls, increasing their interest in STEM fields through the development of gender-inclusive teaching methods, developing their potential and motivation for a future career in the scientific field while fostering pupils' creativity, critical thinking and problem-solving competences.

- **Type of initiative:** European project
- **Organization of the initiative:** international consortium coordinated by [CESIE](#) - European centre of studies and initiatives in Palermo, Italy
- **Type of organization:** The project was coordinated by an NGO
- **Funded by:** Erasmus+ KA 2, Strategic Partnerships for school education
- **Lessons learnt:** This case study shows how the application of the interdisciplinary STE(A)M teaching approach can promote gender-inclusive education, and strengthen teachers' and pupils' competences.
- **History, Goals and Key Aspects:** The focus of the project was on inspiring girls through inclusive STE(A)M learning in primary education, analysing the value of STE(A)M education in increasing the motivation and participation of girls in STEM fields of study. Professional needs of primary school teachers were monitored and improved through the acquisition of new competences to better respond and manage gender perspectives. Primary school pupils (aged 8-11) were involved, targeting at least 80 girls per partner country, stimulating their interest in STEM disciplines and career opportunities. Parents and decision-makers were also actively involved in the research phase, in the learning processes and in the awareness-raising activities.

STEM*Lab - Scoprire, Trasmettere, Emozionare, Motivare

A four-year-long national project involving four Italian regions (Sicily, Campania, Lombardy and Piedmont) focused on strengthening the competences and aspirations of children through the acquisition of cognitive and non-cognitive skills.

- **Type of initiative:** National project
- **Organization of the initiative:** [Kairos scs, Torino](#), a network enterprise based in Turin, Italy
- **Type of organization:** a national consortium of social enterprises, associations and cooperatives in the field of formal and non-formal education
- **Funded by:** Impresa Sociale Con i Bambini
- **Lessons learnt:** The project, which will end in February 2023, showcases how an open school environment can be supported by the creation of places called STEM*Labs, designed to experiment innovative methodologies and resources for STEM education in schools, applying interdisciplinary methodologies such as tinkering, the stimulation of problem-solving skills and the philosophy of "learning by doing". STEM*lab creates and enhances a synergy between the participating regions, implementing transdisciplinary experimental paths in schools as well as the planning of STEM activities to empower families of primary and secondary school students.
- **History, Goals and Key Aspects:** The STEM*Lab project focused on the ability to Search, Transmit, Inspire and Motivate students. It led to the creation of co-designed training workshops for the sharing and use of an innovative teaching methodology for STEM subjects. Local facilities called STEM*Labs were set up as multifunctional spaces able to host teaching activities, workshops and events. Within the labs, educational programmes were piloted based on the input developed in the co-design process, adapting, planning and managing the workshop activities of the transdisciplinary learning and teaching paths.

FeSTEM – Female Empowerment in Science, Technology, Engineering and Mathematics in Higher Education

This project aims to promote an innovative method and pedagogy that allows Higher Education (HE) students to use traditional and computationally-rich media to create meaningful, shareable exhibits that may act as mentoring models for encouraging girls and women to become and remain active in STEM fields.

- **Type of initiative:** European Project
- **Organization of the initiative:** Cyprus University of Technology [TECNOLOGIKO PANEPISTIMIO KYPROU](#)
- **Type of organization:** international consortium coordinated by a Higher Education Institution
- **Funded by:** Erasmus+ KA 2, Strategic Partnerships in Higher Education
- **Lessons learnt:** The project proposes an innovative gender-sensitive teaching methodology for engaging HE students in making shareable exhibits and promoting gender-equality issues collected

in an open source online instrument. FeSTEM offers a community platform for empowering women in STEM and a mentoring community platform for STEM HE students. The tool was based on an analysis of the context of women in STEM from academic and industrial perspective, exploring their challenges and expectations.

- **History, Goals and Key Aspects:** The aim of FeSTEM was to promote an innovative method and pedagogy that allows HE students and instructors to use traditional and computational media to create meaningful, shareable exhibit, acting as mentoring models for encouraging girls and women to remain active in STEM. The novelty of the approach is reflected in the activities that make use of traditional and computationally-rich media through which envisage to expose Higher Education students to successful female role models in STEM and encourage the development of networking opportunities for women to establish a peer support system. The process adopted in FeSTEM is based on the learning theory of constructionism which captures the concept of construction of knowledge by engaging in the making of concrete and public artefacts. By participating in the FeSTEM project, HE instructors got the opportunity to advance their skills to incorporate an innovative, gender-sensitive approach in STEM education, received a gender-sensitive teacher training guide, and promoted a gender-sensitive approach in their teaching. By participating in the FeSTEM project, HE students got the opportunity to straighten their understanding on the challenges encountered by women in STEM, received support from a network of peers and experienced mentors in the field, and advanced their knowledge of traditional and computationally-rich tools.

Il Mese delle STEM - Femminile Plurale

Il Mese delle STEM – Femminile Plurale (The Month of STEM – plural feminine) is a national competition which aims to encourage the reflection on women's participation in Science, Technology, Engineering and Mathematics, contrasting the prejudices and stereotypes concerning women in STEM academic and business field. The initiative targets institutions and schools of all types and levels.

- **Type of initiative:** Competition
- **Organization of the initiative:** The Italian [Ministry of Education](#), University and Research, in collaboration with the Department of Equal Opportunities of the Presidency of the Council, Directorate General for Students, Inclusion and Orientation school
- **Type of organization:** Coordinated by the Ministry of Education - Department for the Educational System of Education and training
- **Funded by:** The Italian Ministry of Education
- **Lessons learnt:** One of the stereotypes existing within the Italian educational system is that female students are less interested in STEM disciplines which leads to a gender gap in their participation in STEM university courses and STEM careers. However, the high participation rates in the contest show a strong interest in STEM by female students.
- **History, Goals and Key Aspects:** The competition aims at raising students' awareness of STEM education and encouraging them to study STEM subjects, regardless of gender. The competition, in

its third edition, proposed the realisation of a multimedia, artistic or literary projects to be chosen from two thematic areas:

- A Girl's Game - projects focusing on a discovery or an innovation made by women in the scientific world, either in the past or in contemporary times, that made a fundamental contribution to the evolution of STEM disciplines.
- STEM Open Access: projects analysing the obstacles and prejudices to access to STEM subjects that female scientists have faced in the past or that female students face today, proposing possible solutions to ensure equal access for female students to STEM education and careers, and a progressive closing of the gender gap in this field.

Well within STEAM – Interdisciplinarity and Inclusion

A blended training course for secondary school teachers implemented in Italy in 2022. The course includes a theoretical-methodological framework regarding the teaching of STEM disciplines with the use of digital technologies.

- **Type of initiative:** National project
- **Organization of the initiative:** [Ministry of Education](#) and partner schools Liceo Scientifico Cavour, IC Belforte del Chienti, Istituto Marymount, CPIA2 Roma, IC Poppea Sabina
- **Type of organization:** The Italian Ministry of Education and partnering Italian high schools
- **Funded by:** NextGenerationEU
- **Lessons learnt:** Educational transitions and inclusive methodologies for an interdisciplinary dialogue presented to secondary school teachers through project work, practical lessons, workshops, specialised lectures and learning communities.
- **History, Goals and Key Aspects:** Participatory action-research course for the construction of a repository of good practices in relation to the themes of interdisciplinarity and inclusion. The course has provided a theoretical-methodological framework through lessons in blended mode (in presence, in synchronous virtual classrooms or asynchronously on a platform), creative workshops for coordinated research-action activities, monitored activities for the development of work outputs and self-training.

Ricci Prize (Premio Ricci)

Target group: high school students, teachers.

Aims: to foster the teaching of STE(A)M disciplines and stimulate students' creativity.

Procedural information: it is a national competition addressed to high school students for the design and realization of an object conceived as a support (or complement) to the learning of scientific disciplines. The competition takes place every two years. The nature of the project to be submitted for the competition is

not precisely defined: a mechanical or computer device illustrating one aspect of mathematics or its application, a series of posters or posters, interactive materials and tools.

[Archimedes Prize \(Premio Archimede\)](#)

Target group: students, teachers.

Aims: to foster the teaching of STE(A)M disciplines and stimulate students' creativity.

Procedural information: the Archimedes Prize is a national competition and its main aim is the creation of new board games. The Prize is dedicated to Alex Randolph (considered the inventor of the profession of game inventors), who was its president for the first 7 editions. For aspiring inventors, it is not only an important showcase where they can showcase their creativity, but above all an opportunity to grow professionally by comparing their ideas with those of other authors and with the experts of the international jury.

[Planetarium of Palermo – Villa Filippina](#)

Target group: children, youth, students, teachers, scientific community in general.

Aims: to encourage the dissemination of scientific knowledge.

Procedural information: The Cultural Association URANIA a.c.s.d. manages "Il Planetario di Palermo" a museum and exhibition space of about 300 square meters, dedicated to Astronomy and Earth Sciences, for the public and schools, plus the outdoor spaces, terraces and lawn of the villa.

Resource and activity: the planetarium organise different events with schools and kids. Worth of mention is the event "Learn science and put it into art", during which the rooms of the planetarium have been enriched with paintings and photographic exhibition dedicated to naturalistic landscapes and with scientific exhibits dedicated to insects and volcanoes.

[PALERMOSCIENZA](#)

Target group: children, youth, students, teachers, scientific community in general.

Aims: PALERMOSCIENZA is a project aiming at offering the possibility to experiment science communication activities in informal situations. The association PALERMOSCIENZA aims at the creation of a Sicilian Science Centre, which is not simply a physical space for exhibitions and laboratories but, above all, a space for a laboratory of ideas that allows different types of users to get in touch with the world of science.

Robotic Team of the High School B. Croce: Robot.202 (Team Robotica del Liceo B. Croce)

Target group: high school students, teacher

Aims: the project aimed at fostering learning of disciplines such Mathematics, Physics and Computer Science. An upgrade path was planned, aimed at learning the contents necessary to carry out the "Mini-robot Race" promoted by the University of Catania scheduled for May 2019.

Procedural information: a project implemented by the High School Benedetto Croce and lasted one year.

When the Past becomes Future - From burning mirrors to solar power panels (Dagli specchi ustori alle centrali solari)

Target group: high school students, teachers, scientific community.

Aims: this one-year project, implemented by the High School Benedetto Croce aims at increasing the number of students enrolled in scientific faculties, to contribute to the construction of some European key competences, by fostering their knowledge in scientific subjects, as Mathematics and Physics. Moreover, it aims at strengthening students' curricula and fostering continuity between high school and university and student orientation. Finally, the project aims at the realization of a technological product made by 30 students, to present at the National Ricci Prize.

Resource and activity: use of computer labs, two temperature sensors, two LCD displays, glue gun, MDF panel, 3D printings.

Teaching strategies: lectures, 6 hours of Mathematics lesson in English language, 14 hours for the laboratories.

Procedural information: the project provides for introduction to coding and robotics to foster the skills of students through the philosophy of "do it by yourself".

[Scientific Degrees Project \(*Progetto Lauree Scientifiche*\)](#)

Target group: high school students, teachers, scientific community.

Aims: the main aims of the project are:

- improving the knowledge and perception of scientific disciplines in high school, offering students in the last three years to participate in stimulating and engaging curricular and extra-curricular laboratory activities;
- starting a process of joint work between School and University for the design, implementation, documentation and evaluation of the above-mentioned laboratories;
- promoting the optimization of training paths and the transition from School to University, strengthening and encouraging internship activities at universities, public and private research institutions and companies engaged in research and development.

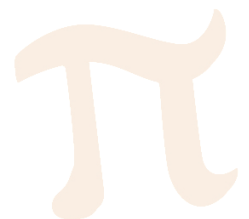
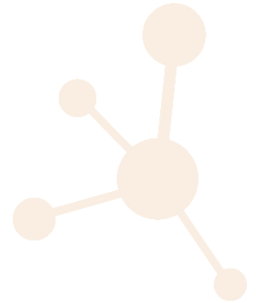
Procedural information: The Scientific Degrees Project is the result of a collaboration between the Ministry of Education, the National Conference of Science and Technology Department Deans and *Confindustria* (The General Confederation of Italian Industry). The project was born in 2004 with the aim to increase the number of students enrolled in the degree courses in Chemistry, Physics, Mathematics and Science; the educational guidance of students was carried out through more than 100 sub-projects.

Mathematic High School (*Liceo Matematico*)

Target group: students

Aims: the project analyzes the relationship between mathematics and literature, history, philosophy, as well as with chemistry and biology, re-launching the role that mathematics has played over the centuries in the social context. The aim is to provide students with knowledge and skills related to mathematics, so that they can consciously orient themselves in the different contexts of the contemporary world.

Procedural information: the *Liceo Matematico* project was launched in 2017 in Palermo. The courses of *Liceo Matematico* make use of the teaching methods and scientific contribution of professors of the University of Palermo and in particular of the Department of Mathematics and Informatics of the University of Palermo. The high school Benedetto Croce is involved in this project.¹



¹ <https://www.liceomatematico.it/palermo/>



Greece

STEM STARS Greece



The STEM STARS GREECE Competition was organized for the first time this year in Greece, in order to support, highlight and reward female students aged 14-18, with a special inclination and talent in science, technology, engineering or mathematics (STEM).

- **Type of initiative:** Competition
- **Organization of the initiative:** NGO SciCo, with the support of the US Embassy in Athens, and the Ministry of Education and Religious Affairs
- **Type of organization:** SciCo² is a Non-Profit Organisation whose aim is to communicate scientific issues to the public via innovative and entertaining means.

SciCo was founded in 2008 and it consist of scientists, academics, educators, artists and people with an interest in everyday science. SciCo operates as a social enterprise.

- **Funded by:** Ministry of Education and Religious Affairs, and the US Embassy of Athens.
- **Lessons learnt:** The participation rates of the contest show that children have a strong inclination in STEM especially when they involve gamification and contests.
- **History, Goals and Key Aspects:** The goals of the initiative are for children to delve into a STEM Scientific field of their, to improve their research, collaboration, presentation and communication skills, to gain confidence in presenting their findings to the public, to be part of a network with people with similar research interests, scientists and STEM professionals.

@POSTASIS

The @postasis project targets real-time artistic education through the development of a suitable platform that enables: the setup of real-time courses within the virtual and physical space, accessible by different participants at the same time (multiuser), the collaborative creation of artistic projects, both in the virtual and in the physical space (e.g. a virtual artistic exhibition, an Internet-of-Things installation), by different participants, the support of large-scale geographically dispersed events and actions brining the above experiences to interested stakeholders and the public (e.g. artistic happenings, transnational projects and seminars, interdisciplinary scientific experimentations). d. the archiving of acquired experiences to new forms of educational material (e.g. e-books).

- **Type of initiative:** Platform
- **Organization of the initiative:** Athens School of Fine Arts, Paris-8 University, Omega Technology, Argenia, MAD Emergent Art Center (MAD)
- **Type of organization:** The project was coordinated by Higher Education Institutions

² Science-Communication. 2020. *Scico*. <http://scico.gr/en/about-us/>.

- **Funded by:** the EU and the State Scholarships Foundation
- **Lessons learnt:** This case study involves a European project which involved methods of gamification, e-learning, design thinking, project-based learning and the use of technologies in higher education.
- **History, Goals and Key Aspects:** The goal of this initiative is for state-of-the art technologies to be better incorporated in contemporary education using platforms for distant education, open courses, virtual realities, and MOOCs. The project started as an initiative among higher education institutions due to the fact that the area that has not been thoroughly exhaustively investigated, regarding artistic education, is that of a real-time education that enables multi-user experiments, the archiving of common experience towards the production of new knowledge, and the support of physically distributed actions in virtual space (like seminars and workshops).

Examples of policies and initiatives that promote the STE(A)M approach are:

- The [CanSat](#) national contest organized by Spin – Space Innovation supported by the ESA and the National Technical University of Athens
- Also, a workshop aiming to help people with special needs come into contact with miniature machines of the museum of [Tsalapata, the Technology and Industry](#) museum of Volos supported with the Cultural Foundation of the Piraeus Bank Group
- [Vodafone Generation Next](#), is a STEM-skills development training program for children about new technologies and science with free access for all. The Vodafone Foundation brings a new educational experience and empowers the "explorers of today" to build the society of tomorrow that they dream of.

eTwinning

“eTwinning” is a European action through which schools from different European countries, using Information and Communication Technologies (ICT) tools, work together to gain educational, social and cultural benefits.

- **Type of initiative:** Platform
- **Organization of the initiative:** The EU and National Support Organisation (NSO) for eTwinning in Greece
- **Type of organization:** National Support Organization for eTwinning in Greece is operated by the Institute of Computer Technology and Publishing "Diophantus" (I.T.Y.E.) with the cooperation of the Ministry of Education and Religious Affairs.
- **Funded by:** the EU and administered by the NSO
- **Lessons learnt:** It provides authentic learning opportunities while fostering 21 century skills. Both students and teachers developed cultural awareness and tolerance, which are pillars in the definition of a multi-ethnic and multicultural society.
- **History, Goals and Key Aspects:** The action was officially launched in January 2005 as an action of the European Commission's eLearning programme and in 2007 it was integrated into the Lifelong Learning Programme as part of Comenius. Since 2014, the European eTwinning action has been

strengthened as part of the Erasmus+ programme (2014-2027), playing a central role in supporting all types of European cooperation in the field of school education. It gives schools from European countries the opportunity to learn together, share their views and create new friendships. More than 29.000 teachers from about 9.100 primary and secondary education units are registered in Greece and about 17.100 collaborative projects have been implemented so far.

[Panhellenic Educational Robotics Competition](#)

- **Type of initiative:** Competition
- **Organization of the initiative:** WRO Hellas with COSMOTE as a strategic partner and STEM education as a scientific partner, under the auspices of the Ministry of Education and Religious Affairs.
- **Type of organization:** Non-profit organization WRO Hellas is the main entity conducting robotics competitions in Greece and South East Europe.
- **Funded by:** WRO Hellas and its sponsors
- **Lessons learnt:** By exploring teamwork, critical thinking, engineer thinking and problem solving in a practical and participatory way, children develop skills that are necessary for them today and for the future, whatever career choice whichever career path they pursue.
- **History, Goals and Key Aspects:** The Panhellenic Competition is organized for the 9th consecutive year. It has three categories for elementary, middle and high school students, while in 2019 it introduced a pilot, non-competitive category for kindergarten children for the first time. Different educational objectives are set for each grade, and therefore different competition criteria. The competition aims to introduce educational robotics, as well as the broader STEM (Science-Technology-Engineering-Mathematics) methodology, into the formal education system. The Panhellenic Competition is a unique way for young students to understand science, programming and automation, learn to think like engineers, develop their problem-solving skills and expand their creativity.

What is relatively new regarding STEAM is the part of the Arts being embedded with Science, Technology, Engineering and Mathematics (STEM) and brings the STEM together with Arts (STEAM). Therefore, this addition is introducing students and educators a more holistic approach in the classroom that involves inquiry, innovation and critical thinking. Teachers in Greece have been trying to motivate the students in order to think of STEAM education and the connection of STEAM education and Greek ethnicity. STEAM is developed to integrate STEM scientific subject categories into various relevant disciplines for education. These constructed programs aim to teach apprentices to think critically and use engineering, technology, natural sciences in virtual designs or creative approaches to real-world problems while building on them mathematics and science base. Thus, STEAM programs add Art to STEM curriculum by depicting on design principles and enheartening and invigorating creative solutions.

In other words, it introduces students and educators to a holistic approach in classroom. STEAM removes limitations and replaces them with wonder, critique, inquiry, and innovation. Considering the importance of helping pupils understand that STEAM education is connected to everyday life, teachers in Greece need to

motivate the students in order to think of the interdisciplinarity of STEAM education and more specifically, the connection that may exist between STEAM education and the Greek culture. In other words, pupils have to cooperate in an interdisciplinary way during discovery, inquiry and experiential learning activities.

STEAM rises up STEM to the next level: it provides students to network their learning in these critical areas together with arts concepts and practices, design principles, and standards in such a way to provide the whole floor of learning at their disposal³.

“STEM or STEAM alone miss several key components that lead to the feasible holistic approach, that many employers, educators, and parents have voiced as critical for our children to thrive in the present and rapidly approaching future. STEM integrated with arts and culture could offer such miss and develop to an educational approach to learning that uses of Science, Technology, Engineering, Mathematics in Arts and Culture as access points for guiding student inquiry, intercultural dialogue, critical thinking, understanding, realization of a common language; that of STEM. The end results are students who take thoughtful risks, engage in experiential learning, persist in problem-solving, embrace collaboration, and work through the creative process, all targeted to an interesting other half; the humanities [...] for example Using proper tools from STEM applied to Arts & Culture could refer to some interesting topics, here we mention some: a) teaching astronomy from astronomical significant monuments, and artefacts, deciphering and simulating myths related to cultural heritage measurements”⁴

In this chapter some of the stakeholders that are involved in STEAM education in Greece are presented. What the chapter focuses on is the initiatives taken in Greece, the best practices, and the sustainability of their actions.

[The Hellenic Education Society of STEM](#)

An example of the national level initiatives regarding the national level is the Hellenic Education Society of STEM.

Target group: students, parents, teachers

Aims: The aims and objectives of the E 3 STEM are to: provide best teaching and learning practices and concepts for the operative delivery of STEM in Education didactics models; provide applied teaching projects/didactic scenario and curriculum activities; provide material towards the clarification of the concepts “STEM in Education” and “STEM epistemology”; promote the implementation of “engineering pedagogy” in Education integrated in STEM Education; provide guidance through the support of STEM based laboratories; provide innovative ideas for implementation of “STEM in education” in curriculum models; create and sustain a national professional association representing the educators in STEM in Greece; preserve and deliver a representative national opinion for member associations; provide a common forum for educators in STEM education at National and International level; cooperate with other organizations and

³ Watson, A.D., Watson, G. H. (2013) cited in Liritzis I. (2018) ‘STEMAC (SCIENCE, TECHNOLOGY, ENGINEERING, MATHEMATICS FOR ARTS & CULTURE): the emergence of a new pedagogical discipline’, DOI: 10.5281/zenodo.1214567

⁴ *ibid*

stakeholders at local, national and international levels; facilitate and provide strategies for the dissemination of STEM epistemology and practices for the teaching and learning process at local, national and international level.; provide support for member associations; organize and conduct workshops, conferences and seminars; be involved in National, European and International projects; publish publications with an International focus; increase community awareness of STEM epistemology; provide a repository with “STEM in Education” learning design activities

Resource and activity: Membership provides access to material, training, advice and support. (E3STEM), can support and represent those in the foundation years of their career as teachers and it runs by providing seminars and workshops to students and schools.

Teaching strategies: The Hellenic Education Society of STEM engages in the development of STEM applications and epistemology with practices linked to the Inquiry Based teaching and learning approaches. It aims to promote the STEM epistemology, computing, computational science and computational thinking, and to advance understanding and education of the STEM methodology alongside with contemporary learning theories and didactic models. It is the only professional body for STEM education in Greece with the vision to grant chartered status to STEM in Education professionals.

Procedural information: the Hellenic Education Society of STEM was first created back in 2017 and is an independent, non-profit, registered professional body and its members work for STEM education in primary, secondary and tertiary education. It is a community of University Professors, School educators and School Advisors who share a common vision for the role of STEM epistemology in promoting education.

[The MATHISI STEM Camp at Moraitis School](#)

Mathisi Initiative is a not-for-profit organization dedicated to introducing innovative and recognized educational programs in Greece in an open and affordable way. It is supported by foundations and private donors. For the summer 2019, it collaborated with the MIT Jameel World Education Lab (J-WEL) to establish an MIT-supported STEM Camp for the first time in Greece (and in Europe) at the Moraitis School in Athens. While we haven't been able to run and expand our scheduled 2020 camp due to Covid-19, we are pursuing our work to be back with adaptive programs in the near future.

Target Group: pre-high school students (12- to 14/15 -year old children)

Aims: provide pre-high school students with local and affordable access to programs of internationally recognized excellence and relevance, to foster independent and curious learners, critical and creative thinkers, and problem-solving young adults engaged in the world.

Resource and Activity; The 2019 Mathisi Camp took place at the Moraitis School in Athens, with the participation of 60 students from 1st, 2nd and 3rd Gymnasium, coming from 20 different schools. The program cost for 2 weeks was €650 and almost a quarter of the students received financial support. Buses were provided along main routes

[CTY Greece – Center for Talented Youth at Anatolia College](#)



CTY Greece at Anatolia College is the culmination of the strategic partnership of three organizations with a long tradition in education and social contribution. Anatolia College, Johns Hopkins University in the US and the Stavros Niarchos Foundation, all came together to establish a centre that is unique to Greece and South-eastern Europe in general.

Target Group: primary and secondary education students

Aims: The program aim offers summer programs that provide the eligible students the opportunity to engage in challenging academic work in the company of peers who share their exceptional abilities and love of learning. As part of the Older Students Summer Day Programs, students enrich their experiences inside and outside the classroom. At CTY Greece the main components of the program’s educational experience are both learning and cultivating social skills, as students develop lifelong friendships. The courses are fast-paced and have high academic requirements, so that they meet the needs of the respective high academic potential children they are serving. The students come from different places and have different educational experiences. For three weeks they are invited to delve into their academic interests while being part of an extraordinary community, without distractions.

Annual International Symposium on the Future of STEAM (sciences, technology, engineering, arts and mathematics) Education

The Natural & Formal Sciences and the Engineering & Architecture Research Divisions of the Athens Institute for Education and Research (ATINER) organize An Annual International Symposium on the Future of STEAM (sciences, technology, engineering, arts and mathematics) Education sponsored by the Athens Journal of Sciences and the Athens Journal of Technology & Engineering.

Target group: educators, students

Aims: The aim of the symposium is to bring together scholars and students of sciences, technology, engineering, mathematics and arts Education. You may participate as panel organizer, presenter of one paper, chair a session or observer. Papers (in English) from all areas of mechanical engineering are welcome.

Resource and activity: The Athens Institute for Education and Research (ATINER) was established in 1995 as an independent world association of Academics and Researchers. Its mission is to act as a forum where Academics and Researchers from all over the world can meet in Athens, in order to exchange ideas on their research, and to discuss future developments in their disciplines.

The organizing and hosting of International Conferences and Symposiums, the carrying out of Research, and the production of Publications are the basic activities of ATINER. Since 1995, ATINER has organized more than 400 International Conferences and other events, and has published close to 200 books.⁵

⁵ <https://euagenda.eu/events/2019/07/22/3rd-annual-international-symposium-on-the-future-of-steam-sciences-technology-engineering-arts-and-mathematics-education-2225-july-2019-athens-greece>

[SMART MATHEMATICS TEACHER \(SMART-MT\)](#): The project integrates innovative ICT methods in the learning process, managing to stimulate the pupil's interest towards mathematics teaching and improving their performance. More specifically, e-tools were created for teaching math as well as for developing the students' critical thinking.


[Mastering Energy Supply focusing on Isolated Areas \(MESfIA\)](#): The project involves the development of an MSc course specialized in Energy Supply for Isolated Areas, aimed at engineer students. The joint collaboration of academics, Engineering associations, as well as local industries, ensures the delivery of strong teaching materials and transfer of valuable skills to create a sustainable energy system for these isolated areas.

Among others, the [CIRCLE](#) project has promoted the social integration of migrants in the educational system, through the development of innovative pedagogies. This project aims at increasing the spread and use of state of the art, effective tools for the assessment and validation of prior learning of newly arrived migrant/refugee students in primary & secondary education. The involvement of several social actors, such as the Family and Childcare Centre from Greece and the Institute for Migration in Germany, were not only able to achieve the exchange of good practices and know-how between European partners, but were also able to influence policy making and measures dedicated for the inclusion of migrant children in the educational systems, as well as the adoption of innovative learning techniques.



Cyprus

ENGINITE



ENGINITE was an Erasmus+ KA2 project that aimed to design, develop and pilot a postgraduate Vocational Education and Training (VET) programme combining advanced applied academic topics with hands-on aspects in order to endorse the knowledge and employability skills of graduate engineers and prepare them for the industry of the 21st century. Upon completion of their training, engineers were placed in companies for hands-on experience in the industry.

- **Type of initiative:** Post-graduate program
- **Organisation of the initiative:** Cyprus University of Technology (Project Coordinator) in collaboration with Aalborg Universitet, Technical University of Crete, CUBEIE L.L.C., GrantXpert Consulting Limited and Useful Simple Projects Limited (Think Up).
- **Type of organisation:** Public Higher Education Institution
- **Funded by:** EU (Erasmus+ KA2 action)
- **Lessons learnt:** The skills acquired through the project's training programme were exactly what graduate engineers needed the most during their internships for their work and what their employers required.
- **History, Goals and Key Aspects:** The goal of this project was to design and promote a postgraduate Vocational Education and Training (VET) programme based on a PBL pedagogy combining advanced applied academic topics with hands-on aspects, in order to endorse the knowledge and skills of graduate engineers. The ENGINITE programme captivates the employability skills of engineering graduates, as well as innovation, entrepreneurial skills, health and safety management, problem solving, communication and presentation skills, while it also enhances technical knowledge in critical fields of engineering. Upon the completion of the training, participants were able to work in companies for three months and apply their newly acquired skills. Ultimately, the programme helps preparing engineering graduates for the industry of the 21st century, enables them to lead multidisciplinary teams, and provides added-value and substantial contribution to their organisation.

Youth Makerspace Larnaca

The Youth Makerspace provides young people with access to high-quality and state-of-the-art equipment, such as 3D printers, virtual reality and robotics, fostering horizontal and transferable skills, use of new technologies, enhancement of creativity, innovation and entrepreneurial mindset.

- **Type of initiative:** Access to equipment
- **Organisation of the initiative:** Cyprus Youth Board in collaboration with Larnaca municipality
- **Type of organisation:** Public Higher Education Institution
- **Funded by:** Cyprus Youth Board & Larnaca municipality

- **Lessons learnt:** During its 2-year-long operation over 2000 young people have participated in workshops, seminars, lectures and other activities reinforcing the development of horizontal and transferable skills.
- **History, Goals and Key Aspects:** Youth Makerspaces represent the democratisation of design, mechanisation, construction and education following the Makerspace standards developed by Higher Education Institutes and other communities abroad. These spaces are hubs for hands-on, project-based learning, creation and invention supporting the integration of Art in STEM subjects. The Makerspace in Larnaca hosts workshops, seminars, lectures and other activities for schools, student groups and families. A lot of students visited the makerspace again following their first visit with their school. Their plan is to reach out to more schools by creating a mobile Makerspace that will visit primary and secondary schools across all regions.

Examples of initiatives that promote the STE(A)M approach include:

- The [EU Robotics Week in Cyprus](#) since 2013, which is organised by one of the company representatives in collaboration with local authority representatives. Students' interest in participating increases exponentially every year. In addition, students become more motivated to study Robotics and Informatics. To date, thousands of students have participated in the EU Robotics Week and hundreds of teachers have attended Robotics seminars, highlighting that there is definitely a huge interest in this field by both students and teachers.
- "[Coding our future](#)" is another successful initiative in Cyprus that began in 2016 by the Cyprus Computer Society and Mathisis to provide the opportunity to students, parents and teachers to become familiar with programming. More than 10,000 individuals have already participated in the programme's events, seminars and workshops that are offered for free with sponsorships from various organisations.
- The [European Space Agency](#) is also organising training workshops for primary and secondary teachers to explore best practices and innovative uses of astronomy and space sciences for education.
- The [Cyprus Pedagogical Institute](#) is also currently participating in a European programme focusing on the design of STEM subjects for primary and secondary schools. It entails a long-term project that demands lots of on-site visits at schools for reforming the existing curriculum in order to introduce the STE(A)M approach.

The STEAMers

The STEAMers is a creative programme that combines the Arts with Science and Technology. The initials STEAM refers to the fields of 'Science, Technology, Engineering, Arts and Mathematics' and form the basis of a series of workshops on Robotics, Coding, Film Making, Photography, Graphic Design, Creative Writing, Music, Drama and Art.

- **Type of initiative:** Informal education programme
- **Organisation of the initiative:** Youth Board of Cyprus (ONEK)
- **Type of organisation:** Governmental body for youth affairs



- **Funded by:** The Cyprus Government
- **Lessons learnt:** The STEAMers programme promotes a learner-centred approach and aims to cultivate participants' life skills such as problem solving, creativity, teamwork, critical thinking, and self-confidence.
- **History, Goals and Key Aspects:** This program started in 2018 and provides the opportunity to participants aged between 6-35 to engage in STEAM activities. The workshops aim for young people's creative development, entertainment and learning, the enhancement of their creativity and communication skills, as well as their personal development and wellbeing.
The workshops are conducted by qualified instructors at the specially designed premises of ONEK in four cities (Nicosia, Larnaca, Limassol and Paphos) daily and the participants are given the opportunity to participate in STEM competitions and festivals such as Robotex, Europe Code Week and Researcher's Night. Each interested party can participate in as many workshops as they wish, depending on availability. The courses start at the beginning of the school year and last until the end of the school year and each workshop costs 30 euro per year. The last two years the STEAMers programme ran a summer school for children aged 9-11.

The STEM programme

In the last four years (since September 2019), the project-based approach in STEM has been pilot-tested in 9 non-compulsory afternoon schools. The afternoon STEM curriculum consists of four STEM-related teaching units that were designed by the STEM Committee at the Ministry of Education. We expect that this initiative is going to be expanded to other schools all over the island.

- **Type of initiative:** Non-compulsory afternoon school
- **Organisation of the initiative:** The Cyprus Ministry of Education, Sport and Youth.
- **Type of organisation:** Governmental body
- **Funded by:** The Cyprus Government
- **Lessons learnt:** This is a student-centred programme that follows a project-based approach to cultivate students' problem-solving skills, analytical and critical thinking, argumentation skills and creative skills. Up to date, there is not an official report from the Ministry of Education on the impact of this programme.
- **History, Goals and Key Aspects:** This programme started in 2019 and thus far it has been implemented in 9 primary schools all over the island. The purpose of this programme is to promote a comprehensive interdisciplinary approach to teaching, involving children in activities that provide opportunities to leverage knowledge, concepts, procedures and practices from the fields of Science, Technology, Engineering and Mathematics, to deal with situations and issues related to the world of everyday life.
The programme is conducted in two consecutive 45-minute periods after the end of the course in compulsory school education (13:05), twice a week and it mainly addresses the 7th grade students (i.e., the last grade of the primary school) who desire to attend. If there's still availability, then the 6th graders are invited to participate as well.

In most of the cases, this programme is integrated in the already established Optional All-Day Schools. In schools that are not part of the Optional All-Day Schools, the morning zone program is extended to the days of the STEM class for 7th graders, to include a meal-break period and two consecutive periods for the STEM activities.

The STEM programme is overseen by the School Administrations, the Primary Education Inspectors participating in the STEM Committee and the relevant Primary Education Inspectors of the schools implementing the program.

Research has shown that robotics integration in education contributes to the teaching of STEM subjects and promotes the development of student higher-order thinking skills, like problem-solving, decision-making, creativity and scientific investigation. Integration of Robotics in the teaching and learning practice represents a tool that enhances their learning experience and support the development of 21st century learning skills. **The Robotics Academy at Frederick University Cyprus**, a research and educational unit, conducts and stimulates educational robotics. Recently, they developed the Educational Robotics Curriculum which was tested in a non-formal educational setting in collaboration with a Private Summer School for kids from 8 to 12 years old. The analysis of the data collected through surveys, observations and focus groups, revealed the positive impact and great potential of this curriculum as a cognitive-learning tool, which increases students' excitement, critical thinking skills, creativity, innovation and collaboration.⁶

STEM programme and Robotics Academy

At Grammar School, the STEM programme has been officially introduced into its curriculum since 2015. Its aim is to educate students in four specific disciplines- Science, Technology, Engineering and Mathematics – in an interdisciplinary and applied approach. Rather than teaching these subjects as separate ones, the programme integrates them into a cohesive learning paradigm. The STEM programme follows a teaching approach relying on applied knowledge, real-world problem-solving, structured inquiry-based learning and students' active and creative contribution. Students learn by doing, designing, making and programming robots or other equipment. The programme aims at enhancing the students' critical thinking, team spirit and creativity. It also provides the knowledge required to emphasise active problem-solving in collaboration with intelligent technology where students are able to create, programme and design applications and real-life scenarios. The programme takes place four times a week and provides students with basic knowledge in various topics, including science and engineering principles, computer programming languages, science experiments and motorized mechanisms, new media design, game development, robotics, research and data analysis, 3D model and design, mobile app development and web technologies. Additionally, students have the opportunity to join the Robotics Academy, an Academy set up as an extracurricular activity that aims at promoting team spirit, leadership and event-organising skills. The goal of the Academy is for students to develop skills and experience for STEM-related careers in fun, creative and innovative ways. Students learn the basics of building and programming miniature robots using LEGO MINDSTORMS. They also have the

⁶ Eteokleous N & Neophytou R. 2019. The case of the Robotics Academy @ Frederick University: 21st Century Skills Developed through a Non-formal Educational Setting. *10th International Conference in Open & Distance Learning*

opportunity to practice team-work, decision making and evaluation of possible solutions and acquire hands-on experience in designing, building and testing. Finally, members of the Academy are selected to take part in Science and Robotics competitions and fairs at a national and an international level and to undergo further intensive training so that they can participate in National Robotics Competitions hosted by the WRO (World Robotics Organisation).⁷

Youth Makerspace Larnaca

The Youth Makerspace was established by the Youth Board of Cyprus in collaboration with Larnaca Municipality in 2019. The Youth Makerspace follows the Makerspace standards developed by Higher Education Institutes and other communities abroad. Makerspaces represent the democratisation of design, mechanization, construction and education. These spaces are hubs for hands-on, project-based learning, creation and invention supporting the integration of Art in STEM subjects.

The Youth Makerspace in Larnaca aims to foster horizontal and transferable skills, use of new technologies, enhancement of creativity, innovation and entrepreneurial mindset. It provides young people with access to high-quality and state-of-the-art equipment, such as 3D printers, laser cutters, drones, virtual reality, robotics, arduino, raspberry pi and many more. Workshops are taking place at the premises of the Youth Makerspace on how to use the equipment, develop ideas, projects and synergies. The space also hosts the Entrepreneurship Development Programme of the Youth Board of Cyprus.⁸

National Competitions fostering STEAM

The University of Nicosia organises an annual competition entitled “Research by Students” and invites students from Middle, High and Technical schools to submit their team-based innovative projects that can focus on social sciences, applied sciences, economics or healthy.⁹

The Research and Innovation Foundation in Cyprus, a public organisation launched in 1996, organises an annual competition entitled “Students in Research” with an aim to cultivate a research and innovation culture. The aim is to familiarise students of primary and secondary education with scientific research processes and to boost their creativity and innovation. Through the competition students are encouraged to go through various stages of the research and development process, such as formulation of hypothesis, methodology, data collection and analysis, experimentation, interpretation of results and presentation of a research process. The competition improves their ability to communicate, explore and work in a team. It also enhances their critical thinking, creativity and initiative. Research topics include among others Sustainable Development, Information and Communication Technologies, Health and Biological Sciences, Technology, while interdisciplinary approach is encouraged.¹⁰

⁷ <http://www.grammarschool.ac.cy/easyconsole.cfm/id/1542>

⁸ <https://onek.org.cy/en/home-page/programs-and-service/creative-activeness/makerspace/>

⁹ <https://www.unic.ac.cy/support/research-innovation-office/research-by-students/>

¹⁰ <http://www.research.org.cy/el/news/mera>

Robotics Seminars for STEM teachers and trainers

The TIME Private Institute in Larnaca in collaboration with Eduk8 in Greece started offering Robotics seminars for the first time in Cyprus in 2019, which are delivered by Teacher Trainers certified by the LEGO Education Academy. The trainers provide the tools and resources teachers need to successfully integrate the LEGO Education Academy's solutions into existing STEM curriculum and daily lesson planning. The seminars provide teachers the opportunity to experience lessons from a student's perspective, master classroom management, and explore best practices in classroom implementation.¹¹

On 10th March 2018, the Pedagogical Institute in cooperation with the private company ENGINO co-organised the 1st national seminar on "STEM and Robotics in Education – State-of-the art approaches and applications" under the supervision of the Ministry of Education and Culture. The seminar was targeted at teachers of all educational levels.¹² Since then, there have been annual seminars on reinforcing STEM education, including the use of innovative and interactive technologies in STEM teaching, the use of Go-Lab, an online educational platform containing online workshops and OERs on STEM subjects.

Target group: Young students in elementary school aged 8 to 19 years old

Aims: The aim of this study was to use Ubiquitous Computing, Mobile Computing and the Internet of Things, collectively referred to as UMI, as both subjects of education and facilitators of the educational process. In order to lay the foundations of their methodologies, a survey was conducted on the use of UMI technologies as educational means and educational subjects in secondary education in Greece, Cyprus and England, which showed that they are mostly used as educational means.

Resource and activity: The making-&tinkering approach involved making, tinkering, programming and playing in a group project integrated into the formal mathematics curriculum using a variety of arts, crafts and technological tools, such as a physical robot.

The Cyprus Pedagogical Institute, Cyprus' main educational institution that was founded in 1972 and undertakes the training of educators of all educational levels, has recently participated in a number of European projects for innovative teaching approaches including:

- a) **EDUCATE: Enhancing Differentiated Instruction and Cognitive Activation in Mathematics Lessons by Supporting Teacher Learning.** **STEAME: Raising STEAM in education**¹³

EDUCATE is a 30-month-long project funded under the Erasmus+ KA2 programme and coordinated by the University of Cyprus, which aims to develop, implement, validate and refine educational materials for educators that integrate cognitive activation through the use of challenging mathematics tasks and differentiation. Prior research has shown that engaging students in

¹¹ <http://larnakaonline.com.cy/2019/08/02/time-private-institute-prosferoun-seminaria-rompotikis-gia-ekpaideftikous-kai-gia-enilikes-ekpaideftikis-rompotikis-stem/>

¹² <https://innovativeschools.pi.ac.cy/education-details-2017-2018/kain-sem-2018-engino>

¹³ <http://educate-platform.com/>.

challenging tasks is pivotal for advancing their problem solving and reasoning skills that are considered key competencies for lifelong learning.

The project ran between February 2017 and January 2020 and addressed academics, teachers and educators from Cyprus, Greece, Ireland and Portugal. The materials developed by the Consortium can be found on the project's learning platform: <http://educate-platform.com/>.

b) **M4TM: Mathematics for the million: mathematics for my world**¹⁴

M4TM is an ongoing project funded by the Erasmus+ KA2 programme that aims to provide an innovative approach to teach mathematics that will enhance existing good practices and support teachers' skills confidence and competence to teach. Moreover, it aims to embrace, instill and facilitate 21st century skills for teachers, pupils and parents.

The **STEAME** project aimed at facilitating learning difficult subjects, such as natural Sciences, Technology, Engineering and Maths through Art by taking a more interdisciplinary and holistic approach based on hands-on experience, experiment and learning-by-doing, as well as enabling artistic expression. The project was funded by the European Commission under the Erasmus+ programme Key Action 2. The partnership involved 5 partner schools from 5 different countries, including the I.M.S (Institute of Maths and Science) Private School in Cyprus.¹⁵

Aims: The aim of the project was to develop an innovative methodology on the implementation of activities and experimental workshops based on the STEAM approach that can be implemented in the classroom.

Resource and Activity: Each transnational meeting of the project explored in depth one STEAM subject in order to develop in a collaborative way workshops, experiments, seminars, tasks, games, flipped classroom and peer teaching, artistic events and academic training material. Topics included Chemistry All Around, Maths and Us, Green Engineering, IT, Robotics, Digital Art and Biodiversity.²³

STEMitUP

The STEMitUP project was funded by the ERASMUS+ programme 2017 under the key action entitled "Cooperation for innovation and the exchange of good practices" in School Education. The partnership was composed of 7 organisations, including GrantXpert Consulting, from 5 Cyprus, Spain, The Netherlands, Norway and United Kingdom. The duration of the project was 24 months between 01/09/2017 and 31/08/2019.

Target group: Teachers, students aged 11/15, parents, career counsellors and decision-makers

Aims: STEMitUP aimed to develop a state-of-the-art comprehensive educational programme that will provide STEM teachers with innovative pedagogical tools that maintain student engagement. The overall aim of the project was to make STEM-related courses 'fun' and interesting for students of lower secondary schools aged 12-15 in order to boost students' skills, knowledge and competences related to STEM combined

¹⁴ <https://sites.marjon.ac.uk/mathematicsforthemillion/contact/>

¹⁵ <http://steam-erasmus.eu/>

with an entrepreneurial mindset and strategically plant a ‘seed of interest’ that could grow into an exciting and rewarding STEM entrepreneurship career.

Resource and activity: The project entailed the identification of the teachers’ training needs regarding STEM entrepreneurship education. Partners went on to develop an innovative training programme that offers exciting activities and read-to-use educational resources for teachers to integrate STEM education, Entrepreneurship and Gender Inclusiveness in the classroom. Resources and activities are freely accessible on the project’s educational platform <https://www.stemitup.eu/platform>.¹⁶

CSRC – Centre for STEAM Education Research, Science Communication and Innovation

The project was co-funded by the European Commission under the HORIZON 2020 programme “Teaming of excellent research institutions and low performing RDI regions”. The coordinating organisation was the University of Cyprus and the partnership was composed of 14 organisations, including GrantXpert Consulting LTD, from 7 different countries. The project’s aim was to create a unique Centre of Scientific Excellence for Cyprus and the East Mediterranean area, focusing on the development of innovative and top-quality research within STEAM Education, Science Communication and interactive and digital technologies for STEAM.

Aims: The project aimed to establish a Centre of Excellence in Cyprus and the Eastern Mediterranean to:

- undertake competitive interdisciplinary research for the development of innovative tools and exhibits for Science, Technology, Engineering, Art and Mathematics (STEAM) Education and Science Communication.
- Promote science literacy and capacity building through informal STEAM education using interactive Science Technology and Engineering exhibits, demonstrations and contact with scientists.
- Contribute towards a Responsible Research and Innovation (RRI) culture
- Provide teacher professional training for integrating in-house developed ICT tools in formal STEAM education and promote integration of new STEAM approaches in education curricula.
- Serve as a hub to communicate and disseminate to public and industry innovative technology research outcomes and evidence-based practice to policy makers.

Resource and activity: During Phase 1, the consortium effectively completed the development of a feasibility study and business plan to allow the establishment of an operational and financially viable centre, the formulation of a CSRC research strategy and the implementation of a range of dissemination and communication activities related to the project for key stakeholders.¹⁷

¹⁶ <https://www.stemitup.eu/>

¹⁷ <https://cordis.europa.eu/project/id/763594>

Spain

EdTechSTEAM

The main aim of the project is to eradicate gender gap in technological entrepreneurship.



- **Type of initiative:** project and awareness raising campaign
- **Organization of the initiative:** Technovation Spain
- **Type of organization:** the project was coordinated by private organization
- **Who funds the initiative:** companies as Cisco, Microsoft etc.
- **Lessons learnt:** The program started about 10 years ago, it is aimed only at girls (1000 participants so far), trying to overcome a little the reluctance that girls have at an age in which we consider that it is key that they be interested in

these issues, which is the age of the institute. It is a completely free program and it is also carried out entirely by volunteers.

- **History, Goals and Key Aspects:** The project was launched with the goals of fighting gender stereotypes in the technological entrepreneurship. Technovation Spain is a network made up of eleven ambassadors who coordinate the program from Madrid, Catalonia, the Valencian Community, Aragon, Murcia and the Canary Islands. Its mission is to locate girls' teams to participate in an international contest that rewards the best applications to solve social problems related to education, poverty, equality, peace, health and the environment. The Technovation award are funds to finish developing the applications or for an educational purpose such as the purchase of school supplies or the financing of courses. The goal to discover for the girls some of the skills and abilities typical of STEM disciplines. It seems that the program is working according to its organizers, after participating in Technovation, 70% of girls around the world are interested in starting studies related to technology.

Girobotica

Girobòtica is a project promoted by the Josep Pallach Institute of Education Sciences and the Higher Polytechnic School of the University of Girona, aimed at primary students in schools in the Girona region, which aims to encourage learning from the resolution of a challenge, closely linked to the current moment and immediate environment.

- **Type of initiative:** Educational Project
- **Organization of the initiative:** University of Girona
- **Type of organization:** The project was coordinated by Higher Education Institutions
- **Who funds the initiative:** The project was partly funded by university (materials) and partly by IT companies.
- **Lessons learnt:** teamwork, innovation, creativity and entrepreneurship among children

- **History, Goals and Key Aspects:** The project fosters teamwork, innovation, creativity and entrepreneurship among children and children from 6 to 12 years old, as well as curiosity and interest in science and technology. It is based on a pedagogical and methodological innovation model called STEAM (Science, Technology, Art & Engineering) that wants to give children the opportunity to identify real problems to find creative and personal solutions, accompanying and leading their own learning process and developing a critical spirit and commitment to society. Teachers need more support to implement activities related to creativity, critical spirit, innovation, curiosity, etc. in this sense we have created Girobòtica together with the University of Girona aimed at primary school students and started a structure similar to that of competitions.

[Inventors4Change](#)

It is an International project, which promotes ChangeMakers education for the 21st century among children from vulnerable groups in India, Colombia and Spain, by involving them through Technologies for creative learning, education for global citizenship and collaborative digital storytelling.

- **Type of initiative:** Project
- **Organization of the initiative:** University of Girona
- **Type of organization:** The project was coordinated by Higher Education Institutions
- **Who funds the initiative:** The project was partly funded by university (materials) and partly by IT companies.
- **Lessons learnt:** teamwork, innovation, creativity and entrepreneurship among children.
- **History, Goals and Key Aspects:** At UdiGitalEdu there are projects to deal with the gender gap in technology and engineering and historically they have focused more during the last decade on the socio-economic gap in Catalonia. The work focuses a lot in primary schools of high complexity which means schools with a lot of immigration which generates some internal dynamics. Every year the "Inventors4Change" challenge is launched which links to one of the goals of the sustainable development of the United Nations and for a few months because the children research on that topic, for example, climate change, refugees and share opinions and learn to use their own voice, learn digital skills and end up programming through Scratch software and creating a collaborative project on what they have researched. It is an example of how to connect with children, connected education and education with values and also that in a transversal way they are developing a lot of digital skills.

[STEM WOMEN CONGRESS \(SWC\)](#)

The STEM WOMEN CONGRESS is a women's empowerment congress in the technological world. From 9 in the morning until 8 at night, in Barcelona was filled with demands to break the gender gap in the STEM sectors (science, technology, engineering and mathematics).

The STEM Awards were also given to projects that break with inequality and gender stereotypes in the sector.

- **Type of initiative:** Congress / competition
- **Organization of the initiative:** Different big companies from Spain and Portugal.
- **Type of organization:** Private companies.
- **Funded by:** Different companies.
- **Lessons learnt:** The participation rates of the contest show that different STEAM initiatives are being carried nowadays for nonprofit entities and schools.
- **History, Goals and Key Aspects:** The event brings together outstanding personalities from the STEM field and internationally renowned companies. At the same time, the conclusions of the third Annual Report, a study that analyzes STEM initiatives during the year 2021, were presented.

Be TalentSTEAM

Be TalentSTEAM is a collaborative platform created by the Capgemini Foundation and the Excellence in Management Club that seeks to promote a transformation of the educational model together with all the stakeholders of the sector, responding to a new reality, linked to the Fourth Industrial Revolution in which we find ourselves. This new situation brings with it a continuous adaptation in the training areas to provide added value tomorrow.

- **Type of initiative:** Platform
- **Organization of the initiative:** Capgemini Foundation
- **Type of organization:** nonprofit organization
- **Funded by:** private funds and comunidad de Madrid and Generalitat de Catalunya
- **Lessons learnt:** 4 pillars

TALENT

Promote talent, creativity and innovation, generating a sustainable technological education.

DISRUPTION

Share knowledge between current and future professionals creating a disruptive educational ecosystem.

TRAINING

Promote STEAM training as a key educational lever for the future employability and professional development of young people.

SUSTAINABILITY

The BeTalentSTEAM initiative works in line with the 2030 Sustainable Development Goals promulgated by the United Nations.

- **History, Goals and Key Aspects:** Creativity, digital transformation and innovation are some of those areas to be promoted. Be TalentSTEAM was born with the aim of being a benchmark, around which we generate a Collaborative Network of educational Stakeholders, who provide high added value to

make Spain a more competitive country, with greater talent and one that reduces social gaps. We will promote talent, creativity, innovation and a sustainable technological education through STEAM training. These will be the key educational levers for future professional development that will allow young people to be employable in the very near future. We are committed to sharing knowledge between professionals in the sectors and those who will soon be professionals, creating a disruptive educational ecosystem that enhances the capacities and qualities of these boys and girls.

Technovation Girls

Global tech education nonprofit that empowers girls to become leaders, creators and problem-solvers.

Technovation Girls program equips young women (ages 8-18) to become tech entrepreneurs and leaders. With the support of volunteer mentors and parents, girls work in teams to code mobile apps that address real-world problems.

- **Type of initiative:** Platform
- **Organization of the initiative:** Technovation
- **Type of organization:** association with collaboration of different companies
- **Funded by:** private companies
- **Lessons learnt:** They use a three-part model to help girls develop greater self-efficacy and change their attitudes towards STEM.
- **1. Identify real-world problems:** Participants find a problem in their community and develop a solution to it, which helps bring technology to life in an immediate, tangible way.
- **2. Build a team:** Participants work in teams—girls work with a group of friends supported by a mentor (and a parent, if the girls are younger than 12!) and connected to a local Chapter or Club Ambassador. Together they brainstorm, share the workload, and cheer each other on. When everyone's contributing, everyone is also building a long-term community of learning.
- **3. Get the Community Involved:** We dedicate time to building trust with the local community leaders who bring Technovation to their schools, organizations, or towns. Technovation programs are designed to be flexible, so they can align with diverse community needs and goals and plug in to existing support networks.
- **History, Goals and Key Aspects:** Climate change, domestic violence, women's equality, poverty — these are just a few problems 1,700 Technovation Girls teams tackled in 2022. Every year, girls across the globe step up to solve problems in their community with technology through Technovation Girls. Supported by a network of mentors, ambassadors, volunteers and parents, **these girls are changing the world**

At a local level we find examples such as the Community of Madrid, which launched STEMadrid last year, an initiative to promote the student vocation of the STEM disciplines in 28 public educational centres. The

Catalan Government also approved at the end of 2019 the STEMcat Plan, a joint program of the departments of Education, Digital Policies and Public Administration, and Business and Knowledge aimed at promoting scientific, technological, engineering, and mathematical vocations. The creation of the STEMcat Plan, along with other programs already in place, such as *mSchools*¹⁸, *donaTIC.cat*¹⁹, *Ciència i Aula* (Science and Classroom)²⁰, *Impulsem la robòtica*²¹ (Fostering Robotics), *Formació permanent del professorat en CTM*²² (Teacher’s Training in Science, Technology and Mathematics), are in compliance with the specific educational policy objectives included in this legislature’s Government Plan.

The national Government has a strategy and initiatives focused on women in the STEAM world, in which regional programs such as Inspira STEAM in the Basque Country is its flagship. Also, there is an initiative focused on increasing computational skills of the students. Both projects are described below.

Inspira STEAM

In June 2017, the regional education department of the Basque Country adopted the UniversityBusiness strategy 2022. Its objectives are to generate knowledge based on scientific excellence and apply it in the business sector, and to train highly skilled people with the skills needed in the business sector. The strategy is aligned with the regional smart specialization strategy (RIS3- Euskadi). The Cluster 4Gune was created in 2017 to foster collaboration between academia and education and training bodies in STEM areas. In 2019, the Plan for the Basque University system 2019-2022 was adopted to strengthen cooperation between the three Basque universities (UPVEHU, Mondragón University and Deusto University) and research, innovation and business organizations (BERCs, Ikerbasque, Unibasq, Clúster 4Gune and Euskampus). In 2018/2019, the universities offer 25 dual-university degrees (bachelor and master’s levels), including training in companies (accounting for 25-50% of credits). Almost 500 students are currently enrolled and 600 private-sector bodies involved. The goals by 2022 are to reach 1 750 students, to increase the share of female STEM students from 32-52%, and to increase the number of jobs in companies for highly qualified workers by 25%.

The Basque Country adopted in 2018 the law on vocational training and in 2019 the 5th Basque vocational training plan 2019-2021. Around 1 500 companies are involved in vocational training. Dual-VET graduates (around 20% of all VET students) have an employability rate of 96.2%. The Basque VET system is widely acknowledged as one of most successful and innovative in Europe²³. The next figure shows the increasing of people involved in this project, only in Basque Country.

	2016-17	2017-18	2018-19	2019-20
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¹⁸ <http://xtec.gencat.cat/ca/projectes/mschools/>

¹⁹ <https://web.gencat.cat/ca/actualitat/detall/Premis-Dona-TIC>

²⁰ <https://www.fundaciorecerca.cat/ca/ciencia-i-aula/sessions-i-tallers-de-ciencia>

²¹ <https://serveiseducatiu.xtec.cat/terraalta/general/robocat-2020/>

²² <https://agora.xtec.cat/cesire/categoria/projectes/ctm/>

²³ https://ec.europa.eu/education/sites/education/files/document-library-docs/et-monitor-report-2019-spain_en.pdf

Mentors	17	102	159	250
Schools	11	44	81	80
Groups	19	124	188	366
Boys	-	1.246	2.062	2.145
Girls	220	1.354	2.078	2.135

Table 1: Inspira Steam in numbers

[The School of Computational Thought](#)

It is a project of the Ministry of Education and Vocational Training which is developed in collaboration with the Councils and Departments of Education of the Autonomous Cities and Communities. The objective of the school is to offer open educational resources, training and technological solutions that help Spanish teachers to incorporate this skill into their teaching practice through programming and robotics activities.

With a sample of over 8,000 students, the research developed is probably the largest worldwide research to date on the development of this skill in education. The results show the following²⁴:

Primary Education: The students participating in the project, who have worked on the mathematical competence through computer programming activities, have developed this competence to a greater extent than the students who have done it with other habitual activities and resources in the area of mathematics.

Mid Secondary Education: The results show that it is possible to develop computational thinking skills through creative technology projects made possible by free computer and electronic material kits sent to participating centres. It should be noted that better results have been obtained in educational centres that had the opportunity to participate in a trade fair in which students share projects carried out during the course with classmates and teachers from other institutes.

High Secondary Education: especially in the 2nd year, the results show that it is possible to use a simulator of robots, drones and autonomous cars -without having physical devices- so that not only is there no penalty in learning regarding computational thinking, but Results are even better than working with programming languages and robotic physical equipment usual for this educational level. The use of this solution, therefore, lowers and democratizes the teaching of this type of technology, also allowing access to (simulated) equipment, which would not otherwise be available to educational centres.

[Teaching Science with Science](#)

Target group: students, teachers

Aims: promoting of STEM vocations through scientific dissemination among young people.

²⁴ https://intef.es/wp-content/uploads/2019/12/Impacto_EscueladePensamientoComputacional_Curso2018-2019.pdf

Resource and activity: The main objective is to bring the results of interdisciplinary research related to scientific education closer to teachers so that they are encouraged to apply them in their classrooms or, in the case of many and many who already do so, so that they feel supported. and reinforced with evidence obtained from dozens of years of research in science education

Teaching strategies: In order to evaluate the success of the scientific dissemination actions carried out and improve its impact, the FECYT, the Obra Social "la Caixa" and Everis have led a project for the definition and implementation of an impact evaluation system that has allowed to objectify the degree to which manages to increase interest in studying STEM of the students participating in these activities and identify key influencing factors in youth vocational decision.

Procedural information: The project has been implemented for two years and it has reached 2.500 students form 12 – 16 years old. The impact it has been quantitatively evaluated conducting only two outreach activities, one workshop of experiments and a conference-dialogue with a scientist, about ESO students, just before these make the decision to follow a future STEM training or not STEM. The main result has been an increased interest in studying STEM of the participating students (5.63%).

[mSchools](#)

Target group: students, teachers, parents, policy makers.

Aims: Encourage learning with Mobile, improve digital skills & entrepreneurial spirit and build an open environmental for mEducation.

Resource and activity:

mSchools is a multidisciplinary, project-based and challenge-based learning that fosters critical thinking and problem-solving skills. It promotes scientific-technical vocations among Primary and Secondary School students through transforming their cell phone into a pocket lab.

- Scratch Challenge: Modular course that uses the free programming language Scratch, addressed to Higher Primary and Secondary Education.
- TechCamp: An immersive workshop experience in app design and development. Students can put their creative power to work conceiving and building apps while learning more about the business of software development and marketing strategies.

A computer science course offered in Catalan High Schools (3rd and 4th year of Secondary School, High School and Professional Training) based on app design and prototype development. Aimed at stimulating entrepreneurial spirit amongst students and with the support of industry experts as mentors.

Teaching strategies:

There are different initiatives to improve teacher's knowledge about STEAM good practices such as Eduhack²⁵ which is a large scale co-creative process for schoolteachers that connects and allows the educational community to develop innovative classroom experiences for all levels and subjects. Furthermore, Mobile Learning Awards²⁶ acknowledge innovative teachers and school-led projects. Finally, there is One-day seminar²⁷ for school administrators and policy makers where representatives from education community and mobile industry discuss the role of technology in education, digital citizenship and the future of work.

Procedural information: [duration and structure of proposed activities, tools and technologies]

Through the capacitation achieved by Eduhack teachers reached 800 students last year using innovative techniques and mobile devices to improve students' digital skills, problem solving and critical thinking. The main tools used are Mobile history map: geo-positioning app that allows students to collaboratively create content on points of interest close to their schools. In addition, there is available Toolbox²⁸: an online repository of validated and tested mobile education content for schools, teachers and parents, designed to increase the availability and usage of educational mobile content.

Being aware of the challenge about having skilled population, the European Commission has invested more than 90 million euros from the Framework Program since 2014 to subsidize initiatives that are dedicated to increasing the attractiveness of science education and scientific careers, as well as increasing the interest of young people in STEM²⁹.

MASDiV

Is a European high-level educational research project focused on evaluation (Erasmus + Key Action 3), whose fundamental objective is to implement effective measures based on research evidence in Europe, in response to social needs derived from the increase in diversity in classrooms and the need to guarantee scientific and mathematical literacy for all, including minorities and disadvantaged groups. European institutions of recognized prestige in Science, Technology, Engineering and Mathematics (STEM) participate in the project, with the collaboration of 11 Ministries of Education. In the case of Spain, work is carried out in tandem with the University of Jaén. One of its objectives is the development, implementation and systematic evaluation of professional development courses for teachers in these fields. The peculiarity of these courses is that they are based on research and specifically designed to, on the one hand, promote scientific and mathematical literacy in all students (including those disadvantaged by cultural and social environments) and, on the other hand, promote the learning of core values in multicultural settings. The effect of these courses on teacher competencies and student learning will be rigorously evaluated through mixed research methodologies,

²⁵ <https://projectes.xtec.cat/eduhack/que-es-edu-hack/>

²⁶ <https://mschools.mobileworldcapital.com/our-initiatives/mobile-learning-awards/>

²⁷ <https://mschools.mobileworldcapital.com/our-initiatives/changing-education-together/>

²⁸ <https://mschools.mobileworldcapital.com/our-initiatives/mschools-toolbox/>

²⁹ <https://ec.europa.eu/research/swafs/index.cfm?pg=policy&lib=education>

combining pre-test / post-test designs with a control group together with case studies. Professional development course for teachers in Spain was offered under the title Tools to improve STEM education in various classrooms in the 2018 summer course call organized by the MEFP in collaboration with the UIMP to download the course modules

STEM PD Net

Is a European cooperation project for innovation and the exchange of good practices (Erasmus + Key Action 2), whose main objective is the creation of a European network of teacher training centres for teachers in the STEM field. The European Network of Professional Development Centres (STEM PD Net) arose from the idea that training centres in different countries should be connected internationally as they have similar goals and agendas: invest in teacher professional development to substantially improve STEM teaching delivered daily in schools. Comprised of 14 prestigious European institutions in the STEM field, this network will support high-quality teacher education through mutual learning, innovation and international exchange, so that teachers can deal with complex realities and diverse in the classroom. On the other hand, it will make it possible to strengthen leadership roles in education, to design the necessary changes and improvements at the institutional level, giving training centres a common European voice.

Its actions are framed in the promotion of European programs to publicize professions in the scientific and technological fields, the compilation and conduct of workshops and training activities for disseminators, the prospecting of professionals needed to carry out tasks of research and innovation in the European Union. It has an educational content platform with services such as the translation of teaching materials into official EU languages and has national representation in about 30 countries.

Eurosteam

Target group: Students, teachers and school support partners from UK, Belgium, Italy, Portugal and Spain.

Aims: improve STEAM skills for students offering educational resources and open and free source materials to be used across Europe to motivate young people in STEAM subjects.

Resource and activity: co-develop 3 STEAM Camps and supporting teacher materials which will be used as an innovative and effective method to directly address the underachievement in basic skills of maths, science, and literacy.

Teaching strategies: provide an online toolkit that will serve as a library for teachers across Europe to access if they need to deliver a STEAM-based lesson or workshop in their classrooms. It is an open source code of free access for students and teachers.

Procedural information: the training camps are focused on three modules: i) Introduction to programming with Scratch; ii) Inside Maths which aims to improve problem solving skills in order to strengthen students' logical thinking using abstract concepts such as variables and the ability to analyse a complex problem; iii) Interactive science, explaining concepts such as microcontroller and the properties of the components installed in an electrical circuit.

The STEAM Alliance – inGenious Education

Target group: Students, industries, ministers of education, and education stakeholders,

Aims: promote Science, Technology, Engineering and Math education and careers to young European's and address anticipated future skills gaps within the European Union.

Resource and activity: [describe the types of activities carried out]

Teaching strategies: [describe the strategies adopted as related to the dimension of the teacher's role]

Procedural information: with the support of major industries and private partners, the **STEM Alliance** for inGenious Education and Industry activities promote STEM jobs in all industrial sectors and contribute to build a STEM-skilled workforce. The **STEM Alliance** will join forces to improve and promote existing industry-education STEM initiatives (at national, European and global levels) and contribute to innovation in STEM teaching at all levels of education.

- 31 different countries involved
- 3 Face to face Activities (workshops)
- 3 webinars and 1 chat
- 12 Major companies supporting STEM Alliance
- 2 European networks coordinating STEM Alliance: 52 companies' resources and 3 communication kits

Actively Engaged Across Europe

- 997 teachers
- 13.000 students
- 120 companies
- 719 schools

Scientix

Is an open community platform for teaching science in Europe that aims to distribute and improve the quality of science while making it more accessible to society. Created in 2010 by the network of Ministries of Education of the Member States and is supported by the Horizon 2020 program of the European Commission of the European Union and coordinated by the European Schoolnet.

Other projects

[Space EU](#); [TIWI-Teaching ICT with Inquiry](#); [BRITEC](#); [Learning Leadership for Change \(L2C\)](#); [BLOOM](#); [STEM School Label](#); [Amgen Teach](#); [Go-Lab](#); [Next-Lab](#)

European Case studies by LLLP

CODINC – CODING FOR INCLUSION

The “Coding for Inclusion” aimed at fostering **STEM education for disadvantaged youth** through an inclusive educational approach based on a **peer-learning pedagogical method** for formal and non-formal educational contexts in Europe. **ACHIEVED IMPACT:** A 10-hour training for students of a secondary school. Every trained student worked with 5 pupils during 5 sessions for 2 hours each. The teachers of the secondary school were trained together with their students. - **150 students** in 5 countries were **trained to teach** coding to their younger peers; - **150 students** in 5 countries have **gained 4 weeks of work experience** (which was the first time for most of them); - **480 pupils** in 5 countries **have learned** the basics of coding, robotics, and making apps in a playful way; - **36 teachers** in 5 countries were **trained to develop coding activities** in their schools. After the first phase of the CODINC piloting activities and after receiving feedback from our partners, we can say that the **project effectively helps young people** develop their critical thinking, creativity, digital and collaborative skills and scientific capital. Most importantly, the **peer learning pedagogical method has a high potential** for inclusion and promotes STEM education and the inclusion of disadvantaged students inside and outside the classroom.

OUTCOMES:

The CODINC Methodology – explains how to engage students through a stimulating pedagogical methodology, specifically how secondary school students (aged 15 and over) can teach basic coding and STEAM education to their younger peers, pupils aged 8-12 years.

<https://all-digital.org/resources/coding-for-inclusion-methodology/>

The CODINC Toolkit complements the methodology and provides teachers and e-facilitators with a training guide to implement the CODINC methodology. The toolkit is divided into two parts, one part is training for high school students (teenagers aged 15-18), and the other part is for elementary school pupils (children aged 8-12). The toolkit offers a series of training provided in modules to facilitate the CODINC training

<https://all-digital.org/resources/coding-for-inclusion-methodology/>

DREAMS - DIGITAL EDUCATION AMONG ROMA MINORITIES IN SCHOOLS

The DREAMS project aimed at fostering **the social, civic, and intercultural competencies of Roma parents through digital education** in order to promote their social inclusion and **tackle discrimination in schools, segregation, racism, bullying, or violence**. The idea was to strengthen the collaboration between schools and families to help Roma parents understand the problems their children face in school, to learn and talk about their rights as parents in the school, and to **be listened to and involved in school activities**.

ACHIEVED IMPACT:



Training of trainers in February 2020;

In the first pilot: **the learners told stories about the school issues** of their children;- **Local events to show the stories – at least 10 for each country** – to peers and family members. Some of them were affected due to the restrictions of COVID-19;- **Digital stories were disseminated** on social media and websites;- **Meetings with the schools showing them the stories**, with the possible involvement of the storytellers;- The second pilot: Roma parents came together to **evaluate the whole process of making a digital story**, with the possible involvement of teachers;- **A methodology was developed** and elaborated into a **toolkit for social workers, teachers, and participants** of the educational system; The toolkit is disseminated and discussed with interested social workers at four webinars.

OUTCOMES:

A final was planned to **present and discuss the methodology and tools used in this process**, however, due to the restrictions caused by the COVID-19 situation, the project coordinator produced this video instead: https://www.youtube.com/watch?v=5wHfQQMdK-0&ab_channel=ALLDIGITAL. Within this video, there are **three short testimony videos** by parents talking about their children.

Innovation camp to create solutions for gender inclusion on the topic of STEM education and lifelong learning.

ALL Digital launches its Innovation camp to create solutions for gender inclusion on the topic of STEM education and lifelong learning As part of the EQUALS-EU Regional Partnership for Gender Equality in the Digital Age, ALL Digital launches a INNOVATION CAMP dedicated to STEM Education and lifelong learning in Brussels, Belgium on 24 June.

The innovation camp is one of a series of hackathons and innovation camps taking place in 24 countries as part of the EQUALS-EU project.

The outcomes of the group work from the participants will be judged by a panel of experts on the topic. The event aims to highlight the potential of women, girls, non-binary people, transgender women.

For each event, teams will develop new gender equity solutions for women and girls' digital inclusion. Each event will focus on the needs of the local cultural context. At the end of each event, a jury of experts and peers will select a solution and team, which will go on to attend the incubator program in 2022. This activity will also synthesis the results of the events to create a roadmap for promoting gender-inclusion innovation.

The 24 winning teams of the Equals EU hackathons and innovation camps will receive the opportunity to further develop their work into a startup through mentoring and training.

[EQUALS-EU](#) is a project funded by the EU Horizon 2020 Framework Programme. This initiative aims to promote gender equity in social innovation through capacity building and creating smart, sustainable and inclusive social innovation ecosystems in local communities and cities in Europe and the Global North and South.

ALL DIGITAL Weeks 2022 campaign “IMPROVING STEM AND STE(A)M SKILLS FOR SOCIETY AND ENCOURAGING GIRLS’ AND WOMEN’S PARTICIPATION IN STEM STUDIES AND CAREERS”

The Week 5 launch event of the ALL DIGITAL Weeks 2022 campaign is focused on an urgent key topic: **gender equality within the professional environment**. Fields within STEM topics are still lacking a gender balance presence and although there are many activities at any level, additional actions need to be taken to change the actual situation and culture.

During the week, events will discuss **how to improve STEM and STE(A)M skills for a better society and life**. Moreover, the purpose of the events is also to involve more girls and women in STEM studies and carriers, to change the ‘traditional’ mindset of considering these sectors an almost exclusive male field.

Apart from the STEM sectors and fields, a gender disbalance is still present within entrepreneurship and management, within the Creative and Cultural Industries, the Gaming sector and more transversal fields where digital competences are combined with leading roles.

The panel discussion wants to discuss what is the current situation at policy level and within specific sectors looking forward on what else could be done to have a more gender balanced society.

[WATCH THE EVENT HERE](#)

Findings

All participants agreed that STEM is not just an educational approach, but the ‘key’ in reinforcing soft skills of students, including innovation, critical thinking, problem solving skills, communication and presentation skills. Participants also noted that it is more difficult to acquire or reinforce such skills in adulthood, highlighting the **need to foster these skills from an early age**, starting from primary school. Together with humanities, STEM is also linked with computational thinking, which does not only involve computers, but also examples of how music and grammar are involved with computational thinking. Over the years, students have been taught computer science, informatics, mathematics, but they were not necessarily introduced to computational thinking. The term “creative industries” has been recently introduced to describe businesses that involve creativity, like design, music, publishing, film and video, crafts and computer games. Creativity is a new phenomenon in economics but it has been gaining ground the past few years.

Positive measures that promote STEM education with a STE(A)M approach include **workshops and seminars** organised by public authorities for primary and secondary school teachers focusing on innovative approaches, robotics and ICT-based tools in STEM education.

Issues at university, labour-market and policy level demonstrating the necessity of adopting a STE(A)M approach to STEM education since school

However, such training is often organised **outside working hours**, making it impractical for some teachers to attend. Additionally, although most teachers are motivated to learn new approaches and to learn how to use innovative educational tools, **no funding** is available to equip public schools with Robotics or ICT-based tools for educational purposes. Finally, further training rarely contributes to the teachers’ professional development and/or promotion in public schools. As a result, **teachers working in private schools** are more likely to attend training courses until completion. Therefore, there is a need for additional motives to be set by the Ministry of Education in order to motivate teachers to pursue further training and learn new educational approaches in STEM education. The teachers need more support to implement these types of activities where creativity, critical spirit, innovation, curiosity, etc. must be implemented as they should be given more support.

An important input from the focus groups was that there is a **lack of a common framework** to assess and evaluate STEM skills. A common framework and structured curriculum to use for STEAM education at a global level would enable monitoring and evaluating the impact of STEAM education on outcomes and students’ skills, such as ability to communicate and critical thinking skills, as well as continuous improvement. For this a structured curriculum with measurable outcomes that can work for all initiatives in STEM education at a global level can be developed. Current efforts are being made by different initiatives to categorise skills by age, but **no consensus** has been reached among these initiatives yet.

The real challenges that prevent the introduction of STE(A)M approaches in STEM education comprise: a) the **existing curriculum** that includes separate subjects of STEM instead of one that follows an integrative

subjects approach; b) the lack of innovative and high-quality **educational material** that reinforces students' interest towards STEM; and c) the **scarcity** of Vocational Training and professional development of teachers in STE(A)M approaches and ICT tools for educational purposes.

Measures and practices adopted or proposed by the selected businesses and academic institutions to increase motivation among young people

There are many countries that involve support policies for creative industries and these begin with education. In both formal education and lifelong education there are measures that can be adopted to support creative industries, for example: In formal education on a national level, universities can build flexible curriculums for creative industries and support their cooperation between them and private companies, especially in interdisciplinary programs. On regional and local level, **creativity and entrepreneurship** can be promoted at school along with ICT education support. In lifelong education, programs of **requalification** in the field of creative industries and support of talented individuals, along with organizing competitions for individuals in creative industries and courses/training programs are measures that can be implemented in development strategies. Each measure has its own drawbacks and strengths, so the local environment must be studied in order to properly design adequate support policies.

Regarding the issues on school level that impede the promotion of creativity in STEM subjects, the participants agreed that the schools could introduce **actions** that will be based on the **cooperation of educators** of various disciplines.

Measures to include both male and female students to the field of action of STEM were discussed as well. STEM company representatives made the point that the familiarization of children with the concept of scientific methods from an early age are a necessity, for example the introduction of algorithmic thought has entered primary schools with emphasis on problem solving and critical thinking, robotic and experimental methods that cultivate logic. A point made regarding the inclusion of women in STEM careers, was the inclusion of **more female scientists as role models** in the school material during the school years. A HEI rep pointed out that the male to female ratio in his field at the university is roughly 10:1. However he stated that some women are culturally shaped to be a lot more talented in certain crafts such as jewellery and they have great precision in their movements. For example, if there are dedicated courses to discover one's inclination, people who are not entirely sure about their talents will understand that they have such an inclination.

Additionally, it was supported by the reflective group that the STE(A)M approach greatly increases the interest of girls because it makes sciences more attractive and gives another meaning/interpretation to science. A **lack of knowledge** on the level of the educators was also pointed out, as teachers may lack knowledge in the field of arts. Therefore, a **strengthening of skills** of educators regarding STE(A)M is needed. A great example is the teaching of graphic design for both teachers and students, which is considered the basis, the very **beginning of all visual arts**, starting from the concept of proportion/perspective to shading. It is also greatly connected with our everyday lives in many situations.

The discussion concluded with the participants agreeing that the problem that concerns the STEM enthusiasts does not only involve the students, but also the teachers. The project CHOICE is aimed at the teachers and the message that they want to send to the kids about following a STEM career. The teacher must love the STEM subjects first, even if they are not directly involved in the teaching procedure of these subjects. There is the need for more **intense involvement** of both the professors and the university students. One of the HEI representatives noted that there are students at the university who are quite proficient in STEM studies and very talented, but do not necessarily love science. Another HEI representative noted that the love for STEM subjects starts from a young age, so instead of buying a young girl a conventionally girly toy, we could **consider buying her a toy robot** instead. Moreover, it was highlighted that less developed countries and immigrant students show more openness for the complexity of the STEAM education compared to developed countries where children have all facilities and it is hard to find the motivation to study careers which require a higher effort. They propose to educate children differently from a young age, for example help them to think and enjoy what they are doing. Because if there is not a challenge of something that excites or motivates them, they will hardly choose these areas.

Conclusion

In conclusion, all participants agreed that although there are multiple individual initiatives, **a joint effort is required** by all stakeholders, including local authorities, policymakers, companies and academia, in order to be able to reform STEM education at school and introduce innovative STE(A)M approaches into existing curricula. There is also a need for a European and a national platform that will include all of the initiatives, projects and programmes focusing on STE(A)M approaches in order to collect the educational material following a STE(A)M approach that was developed through these initiatives in one central place. This would greatly facilitate the reconstruction of STEM education. Even though there have been lots of initiatives that promote STE(A)M approaches, the majority are promoting a positive culture among students, teachers and parents towards STE(A)M, but do not seem to contribute to the **reform of the STEM** curriculum at schools. This need is in line with the goals of the project CHOICE that aims to be instrumental in promoting policies that support STEM education (with a STE(A)M approach) and in reforming the school curriculum.

Annexes

Annex 1

Reflective Group Meeting Report Template – provided by EUROTraining

PLEASE NOTE: Each partner who hosts a reflective group meeting should compile ONE relevant report for EACH focus group based on this template, so ***each partner will produce two reports in total.*** In this way, the partnership will be able to utilize the results of all reflective group meetings, thus improving the quality of the Project's outputs. However, due to the COVID-19 restrictions, partners can hold ONE single meeting, including all foreseen participants (6 in total) and, therefore, provide one overall report.

Country: _____

Date: ___ / ___ / ___

Time: _____

Duration: _____

Location: _____

1. Methodology

In this section you can describe the methodology you used to conduct the reflective group section, including the following information.

Information on how you recruited your participants; what is the structure of the meeting; duration of the session; name and short profile of the facilitators; highlight here challenges and difficulties regarding in the organization of the meetings.

2. Profile of participants

In this section please provide a brief overview of the participants in the reflective group, including a short summary for each one. Ask for permission to use their photographs.

For example:

- (Imaginary profile) participant from HEIs: **Dr Chiara Venturella**, PhD in Applied Mathematics. Dr Venturella has been working in the University of Alicante for 5 years, she has experience in ..., we chose her because of her deep knowledge in academics, etc.
- (imaginary profile) participant from company in the STEM field: **Nayia Nicolaou**, CEO in the company 'ACES' AEROSPACE ENGINEERING. Mrs Nicolaou has been the CEO for the company for 6 years and she specializes in..., we chose her because of her vast knowledge in business regarding STEM topics, etc.

- *(imaginary profile) Estel Guillaumes, member of the Chamber of Commerce and Industry. Mrs Guillaumes is the best candidate to speak about the issues in the field, etc.*

3. Synopsis of case study

➤ -NAME OF INITIATIVE 1-

Write here a short description of the initiative (3-4 lines)

4. Case Study Overview

- **Type of initiative:** (write here: MOOC or Project or whatever it is)
- **Organization of the initiative:** (write here for example: the university of Athens, or whatever it is)
- **Type of organization:** (write here for example Public institution and NGO, or Private School or whatever it is)
- **Who funds the initiative:** (write here for example: the government, or the EU, or the QRF Foundation)
- **Lessons learnt:** (write here about the transferability perspective, why do you consider this case study successful, why is it interesting and useful to our project)

5. History, Goals and Key Aspects of the Initiative

(write here the **goals** of the initiative, the **objectives**, the aims and **how it started**)

6. Comments and findings from the Focus Group

Please summarise the main points of the discussion based on the following questions:

General questions for the participants

1. *What is your knowledge about STE(A)M approach to STEM education?*
2. *How did you decide, to become a teacher/etc? What were the courses that motivated you to do it? (for teachers)*
3. *Do you think that your position reflects your skills with regards to STEM courses, such as Engineering together with Arts and Mathematics?*
4. *Do you find it easy to teach students STEM courses? (for teachers)*
5. *What do you think are the **issues** at university level that show us there is a necessity for a STE(A)M approach since school?*
6. *What are the issues at labour-market level that show us that necessity?*
7. *What are the issues at policy level that show us that necessity?*
8. *What are the positive measures adopted in your working context that promote STEM education with a STE(A)M approach?*
9. *What are the initiatives in your working context that promote that?*
10. *What are already existent measures and policies that promote that?*

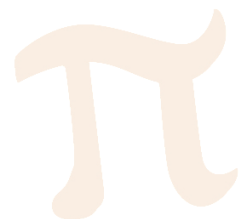
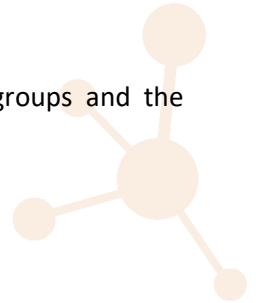
Case Study Questions



1. Which was the challenge and the causes in the case study?
2. What means were used to increase young people's interest in STEM subjects?
3. What means were used by the persons involved?
4. Which were the results of the actions taken to increase interest in STEM? How were they identified/measured?

7. Conclusions

In this section please provide a synopsis to highlight the key points of the reflective groups and the conclusions.



CONSORTIUM



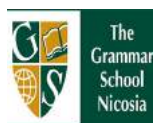
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