



EUROPEAN POLICYBRIEF



STE(A)M LEARNING ECOLOGIES (SLEs): OPEN SCHOOLING FOR SCIENCE EDUCATION AND A LEARNING CONTINUUM FOR ALL

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INTRODUCTION AND POLICY CONTEXT

Open schooling is gaining momentum in Europe, enhancing the accessibility and flexibility of education. This transformation aligns with the growing interconnectedness and interdependence of societies worldwide, all while navigating increased competition in the realms of science and technology. To confront the demanding societal issues, it is imperative that every citizen possesses a strong foundation in science and technology. Such knowledge is the bedrock for informed decision-making and fostering innovation, and the policies pertaining to science education wield substantial influence over a society's long-term economic growth and prosperity.

In recent years, Europe has observed a decline in student interest in careers related to science and technology. Furthermore, a substantial gender gap in STEM fields persists, and there has been limited growth in science-based innovation or entrepreneurship. Consequently, Europe faces a shortage of individuals with scientific expertise. To overcome these challenges, the need to boost education and teacher training systems is imperative.

In response to these concerns, the European Union launched its revised **Digital Education Action Plan (2021-2027)**. This initiative seeks to aid EU member states in the sustainable and effective adaptation of their education and training systems to the digital era. It places a strong emphasis on gender equality, particularly by encouraging women's participation in STEM fields. The importance of gender equality in education is underscored in both the Education 2030 Agenda and the UN Sustainable Development Goals (2015). These endeavors advocate for inclusive, equal, and diverse education.

A pivotal moment, emphasizing the priorities and efforts required to reform science education policy at the European level, unfolded in 2015. The expert group on science education of the European Commission released its report titled "**Science Education for Responsible Citizenship**." This report identified the necessity for science education to be a lifelong learning process, commencing from preschool and extending into active citizenship. It also recommended a shift from STEM to STE(A)M by integrating science with other subjects and disciplines. The report highlighted the significance of collaboration among various educational institutions, enterprises, and civil society to engage individuals with science and stimulate interest in science-related studies

and careers. It promoted "open schooling" where schools collaborate with diverse stakeholders on practical projects, thereby fostering partnerships and community involvement. Furthermore, the report acknowledged the critical role of facilitating the sharing and application of scientific research findings among educators, researchers, and professionals from various sectors for mutual learning and progress.

In addition, the **EU key competence framework** for lifelong learning, adopted as a Council recommendation in 2018 has prioritized essential knowledge, skills, and attitudes for lifelong learning, including science and mathematics.

In essence, open schooling within science education policies in Europe are undergoing transformation to address the evolving educational landscape. They aspire to encourage lifelong learning, interdisciplinary approaches, and active community engagement, aligning with the needs of an increasingly interconnected and competitive world. These policy initiatives aim to equip individuals with the knowledge, motivation, and sense of societal responsibility needed to actively participate in the innovation process and confront intricate societal challenges.

In relation to inclusivity and social impact, research recognizes that a STE(A)M learning approach, by focusing on creating creative and innovative environments, is also beneficial for the inclusion of all student learning styles and disabilities (e.g. gifted children, those with special education needs etc.) and recognizes the potentiality of an open schooling approach involving the community to enhance education as well as social stimuli in more deprived school areas.

Additionally, the fourth objective of 'A new ERA for Research and Innovation' policy (COM (2020) 628 final) consists of deepening the **European Research Area** (ERA) to promote the free circulation of knowledge connecting all actors across Europe, including in education, training and the labour market. Through science education and other RRI (Responsible Research and Innovation) principles, the outcomes of Research and Innovation (R&I) are understood, trusted and increasingly used, by scientists, researchers, entrepreneurs and informed citizens to the benefit of society.

In this context, the STE(A)M Learning Ecologies (SLEs) project aims to create new open schooling partnerships in local communities to foster improved science education for all citizens and to contribute to a learning continuum for all. This policy brief outlines initial findings and recommendations about the challenges and opportunities associated with the use and mainstreaming of open schooling in science education and through the creation and development of STE(A)M Learning Ecologies across Europe.

OBJECTIVES AND METHODOLOGY

The SLEs project aims at promoting science education as part of local community development through the creation of open schooling partnerships between formal, non-formal and informal education providers, civil society and enterprises working together on real-life problem-solving situations within local communities. To this purpose, SLEs introduces the powerful concept of STE(A)M Learning Ecologies as partnerships able to provide multiple science learning opportunities for all citizens in a learning continuum of different learning spaces.

In the first six months of implementation, from January to June 2023, SLEs developed an initial methodological framework for the creation of STE(A)M Learning Ecologies (including the SLEs White Paper and the SLEs Methodology First version), which will be validated and improved based on the experience of two SLEs implementation cycles across Europe.

The first small-scale pilot implementation of SLEs in 13 countries has started in autumn 2023. In this context, SLEs partners organised several co-creation workshops involving numerous stakeholders (teachers, educators, researchers and experts, representatives of science museums, industry, civil society, and public authorities) who are joining forces at local level to develop and implement learning ecologies.

During the first year of the project, evidence was also collected through surveys from SLEs project partners, who monitored and analysed policy developments at national level to provide background, context, and perspective for the development of the SLEs policy recommendations. This analysis was carried out in twelve project countries, namely: Cyprus, Germany, Greece, Ireland, Italy, Malta, Norway, Romania, Serbia, Slovakia, Spain, Sweden. The purpose of this activity was to gain an understanding of the current state of open schooling in these countries with a view on the challenges and opportunities associated to it in science education. The analysis focused on national policies and initiatives that are associated with, benefit from, or have the potential to incorporate the STE(A)M Learning Ecologies approach for fostering open schooling and inclusive STE(A)M Education accessible to everyone.

The results of this analysis have been shared with and validated by the Scientix Ministries of Education STEM representatives Working Group¹, ensuring the correctness and relevance of the collected information, as well as with the SLEs project partners coming from 13 EU countries. The SLEs policy dialogue event that took place in the European Parliament (Brussels) in January 2024 involving key representatives from DG EAC and DG RTD of the European Commission and Open Schooling EU-funded projects² served as a further validation step.

EVIDENCE AND ANALYSIS

According to the collected evidence, open schooling linked to multistakeholder partnership and STE(A)M education addresses crosscutting challenges in the project countries. These are related to economic growth and the alignment with labour market needs, lifelong learning, active participation and citizenship, environmental education and sustainability, teacher competences, educational quality and innovation, and ensuring inclusion of all children in education.

Open schooling and STE(A)M learning initiatives at EU level:

Several different initiatives launched by the European Commission have been launched to support a next generation of equipped talents such as **“Girls Go Circular”**, that aims to equip the teenagers with skills needed for the circular economy; the Digital Education Action Plan, focusing on the Entrepreneurial skills of students; **“Science is wonderful”** initiative, which connects research and schooling in an Annual science fair hosted in April in Brussels for more than 3000 pupils, through interactive and co-created games and materials. **“Researchers’ at school”** call, which enables researchers to enter classrooms all year-round bringing games, discussion and a playful approach. Finally, to support interconnections amongst subjects through a STE(A)M approach supporting teachers happens through initiatives such as **“European School Education Platform”** or the **“STEAM Academy”**.

Open schooling and STE(A)M learning in EU countries: policies and initiatives

Open schooling is present in official policies in different European countries, such as Malta, Italy, and Germany, through the establishment of partnerships with external stakeholders, networking for out of school learning opportunities, and supporting extracurricular STEM projects. The **“Community educational agreements”** (2020-2021) in Italy, between schools, local authorities, public and private institutions and third sector represents an interesting example of how collaborations are formally established between schools and the local community to reduce early school leaving. In Malta, open education and open educational resources are embraced in national

¹ Including Ministries of education representatives from: Belgium, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Greece, Hungary, Italy, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Serbia, Slovakia, Spain, Switzerland, Turkey

² Schools As Living Labs (SALL) project, RoadSTEAMer project; Open Schooling together cluster.

learning strategies. The Government in Germany supports out of school learning and extracurricular projects through STEM plans and partnership guidance.

In some other instances, open schooling and the establishment of educational partnerships does not appear in official documents, however, stakeholder collaborations are developed within educational initiatives and programmes such as School Science clubs and Science festivals (as in the case of Spain), or when working on specific topics such as climate change education, outdoor learning or digital education, as in the case of Sweden, Slovakia and Romania.

Another group of countries, such as Greece, Cyprus, Ireland and Serbia do not present official policies related to open schooling yet, but rather focus more clearly on ensuring lifelong learning and STE(A)M education through interdisciplinarity and the enhancement of 21st century skills.

Enhancing female participation in science education and careers through local stakeholder partnerships is a common practice in almost all analysed EU countries. Educational initiatives, often in collaboration with local foundations and associations, such as **“Women in science”** (Germany), **“STEM it like a girl”** (Serbia), **“Girls4STEM”** (Malta), **“Coding Girls”** (Italy) are intended to raise awareness against gender stereotypes in STEM education, while also supporting career development and orientation for women in STEM subjects through role models, outreach, or mentoring activities.

Collaborations between education, research and industry, promoting transferring of research results and lifelong learning is often an occasional and informal practice in the project countries. Lack of funding and connection between research & development and companies is one of the possible challenges. Activities promoted by the private sector are intended to enhance learner engagement in schools, by bringing innovations, hands-on learning, or supporting career orientation and entrepreneurship through counselling, fellowships, and mentoring programmes. These are especially driven by the biotech or green sector (e.g. Italy, Malta, Germany). Only in the case of Ireland, Malta and Romania, partnerships are formalized between research and universities with the aim to expand STE(A)M education and transferable skills.

SLEs good practices and inspirational initiatives are already present in different EU countries and include summer camps (e.g. Girls4STEM in Malta), afterschool activities, school labs, out of school visits, science festivals and exhibitions (e.g. European Researchers’ Night in Italy), learning communities (e.g. Galway STE(A)M Learning Community, Ireland) or edutainment science museums. Such experiences are, however, usually ad-hoc initiatives, or informally promoted. Sustainable and long-term SLEs models are either linked to EU funding and programmes (e.g. Schools as living Labs, SEER, OSOS) or are present on some occasions in national initiatives (e.g. the “Butterfly project”, in Cyprus, engaging multiple stakeholders such as schools, universities, museums, policy makers).

Challenges identified in SLEs implementation

Major obstacles in the implementation of STE(A)M open schooling can be summarized as follows:

- **Interdisciplinarity:** There is a lack of opportunities for teachers to collaborate with colleagues across STEM subjects and non-STEM disciplines and there is still a low level of multidisciplinary in the curriculum and taught approaches. A need for more cross-disciplinary and interdisciplinary approaches is addressed, since interdisciplinarity is often still regarded as a secondary approach to the traditional disciplinary one.
- **Multi-stakeholder partnerships in education:** Partnerships are seldom supported by local authorities. As long as collaborations are voluntary or informally established, schools will perceive them as extra work and will encounter difficulties in connecting with other stakeholders. Adequate support is necessary for stakeholders to organize effective learning paths.

- **Policies, resources, funding and capacities:** Higher attention is still needed from national and European policies to have educated and informed citizens on science-related topics. Lack of facilities and resources constraints represent another major obstacle in the implementation of STE(A)M learning Ecologies. Schools lack adequate funding to adopt innovative approaches and teachers lack adequate training opportunities to foster open, inclusive and innovative STE(A)M education.
- **Flexibility:** Time constraints, lengthy bureaucratic procedures, lack of flexibility in curriculum and assessment are sever challenges for the implementation of a SLEs from the school perspective.

POLICY IMPLICATIONS AND RECOMMENDATIONS

Based on the collected evidence, open schooling policies and initiatives linked to STE(A)M education and multistakeholder collaborations are in place in some European countries, but still need to be mainstreamed and implemented in a structured way to advance towards sustainable and long-term learning models. There is also a strong need to **investigate more on the impact** of existing EU-funded projects and better **support, promote and scale-up effective STE(A)M learning paths across Europe.**

We provide a set of initial recommendations targeted to different stakeholders to contribute to the advancement of open schooling and STE(A)M learning ecologies, fostering a more inclusive and dynamic educational system that prepares learners for the challenges of the future. Overall, it is important to ensure that **learning is relevant and applicable** to students' lives and that its goals are aligned with the needs, values and aspirations of the community and the broader society.

European policy level

- Overcome the fragmented sectorial approach between Directorate-Generals in the European Commission would enable to adopt a **more coordinated approach**, aligning EU funded projects with broader, holistic strategies.
- Provide national ministries with policy **support and guidance** in developing new policies for open schooling and science education.
- Create conditions for open dialogues to **co-create policy recommendations** between science education practitioners and relevant DGs and Parliamentary representatives at EU-level.
- Increase **funding** in research and innovation to deepen the ERA policy agenda and make the outcomes of R&I understood and increasingly used by educated informed citizens for the benefit of society.
- Include **science education** as requirement in R&I calls and/or proposal templates, to mainstream and support the adoption of science education practices for raising awareness and co-design research findings.
- **Support financing the upscaling and mainstreaming** of results of SLEs and other similar STEAM open schooling projects to guarantee the promotion, impact and sustainability of the project results.
- Increase support for transnational projects to foster cross-border collaboration and exchange of best practices in formal and non-formal education.
- Position the STE(A)M Learning Ecology as a holistic approach within science education in the European initiatives and policy approaches, emphasizing its role in preparing citizens for future challenges across various subjects and learning environments.

National policy level

- Formulate a **clear national-level policy** dedicated to STEM and STE(A)M education to guide the effective implementation of the STE(A)M Learning Ecology.

- Promote **integration** between knowledge and skills in arts and humanities and natural sciences, mathematics as well as technological and technical disciplines (STE(A)M) **in education policies and national curricula.**
- Introduce **open schooling as a formal component** of the national curriculum and evaluation system, making it easier for schools and teachers to adopt these practices.
- Recognize the **benefits** of an open schooling STE(A)M approach to support **inclusive learning environments** for all types of learners (e.g. with different learning styles, students with special educational needs and disabilities, living in disadvantaged socio-economic school contexts etc.)
- Provide comprehensive **training programs for teachers** to facilitate their engagement with multiple stakeholders, fostering effective implementation of the STE(A)M Learning Ecology.
- Enhance funding opportunities to strengthen **collaborative projects in schools** (collaboration between different partners / research + industry / girls in STEM etc.).
- Increase funding opportunities for research and innovation on open schooling and science education across countries.

Education authority level (National Agencies and all relevant stakeholders)

- Develop a **shared vision** for STE(A)M education and discuss and develop a common understanding of the role of STE(A)M education in preparing students for the future and in addressing societal challenges.
- Establish **clear goals and expectations** about STE(A)M achievements, and make sure that the goals and expectations allow for **continuous evaluation and improvement.**
- Promote women **role models in STEM careers**, with a particular emphasis on showcasing **young women** in these fields. This can be achieved through targeted campaigns, mentorship programs, and initiatives that highlight success stories.
- Comprehensively **integrate innovative approaches** with the curriculum, which requires intensive collaboration among educators, curriculum developers, scientists and innovators, industry experts and the integration of science, technology, engineering, mathematics (STEM) and the arts (STEAM).
- Create **spaces and conditions for collaboration and coordination** amongst all relevant stakeholders (educators, curriculum developers, scientists and innovators, industry experts, policy makers).
- **Co-create policy developments**, and advocate for comprehensive policies that will promote ambitious goals and include funding for curriculum development, professional development, school facilities, mobility, as well as for raising public awareness.

Educational practice and teachers' level

- Adopt innovative **STE(A)M learning approaches** promoted and developed at European and national level, such as hands on activities, project-based, experiential learning, whereby students apply their knowledge and skills to real-world problems.
- Use the materials and tools available in different platforms at European and national level for science education.
- Develop and implement **continuous professional training** to equip educators with the skills and knowledge needed to effectively implement open schooling and STE(A)M approaches, stay up to date and evolve, through content knowledge, innovative pedagogy and use of technology.
- Provide teachers with **space, time, opportunities, motivation**, and structured curricular plans that encourage the implementation of effective STEAM learning and the collaboration within their schools and with external partners.
- Create **supportive and inspiring learning environments**, fostering a culture of exploration, creativity, innovation, collaboration, love of learning and resilience.
- Recognize the role of **school leaders** in a distributed perspective to support within school collaborations and provide teachers with the adequate support needed.
- Develop truly **collaborative, mutually beneficial partnerships** with community organizations (e.g. museums, universities, businesses, local authorities, NGOs etc.). Higher

attention is still needed for the establishment of **research-education-industry partnerships** to foster student entrepreneurship and career opportunities.

- Encourage continuous interaction with the **community** to ensure that open schooling remains responsive to local needs and challenges, therefore opening the school to the community and the community to the school.

YEAR 1 PROJECT OUTPUTS

In March and June 2023, the SLEs consortium published two important documents that form the basis of the STE(A)M Learning Ecology framework that the project aims to create, implement, and evaluate: the SLEs Concept White Paper and the SLEs Methodology first version.

The [SLEs Concept White Paper](#) describes the main foundational elements on which the SLEs approach and vision are based: STEAM Education (overarching approach), Open Schooling environment (main pillar), and Living Lab approach (key practice). The White Paper also puts forward the concept of learning ecologies, offering a powerful new way to envision local open schooling partnerships, and describes the driving needs, policy context and relevant initiatives about open schooling in science education.

The [SLEs Methodology](#) is a comprehensive document presenting a methodological framework for the development of the STE(A)M Learning Ecologies. Consisting of guidelines to facilitate a co-creation process and establish partnerships, stakeholder engagement, step-by-step SLEs development process, examples of successful SLEs, this deliverable offers a wide range of theoretical and practical concepts and ideas to National coordinators, educators, and other relevant stakeholders of the SLEs project. The SLEs Methodology also forms the basis for the SLEs Pilot cycle, and it will be revised based on the feedback received from the piloting phase.

PROJECT IDENTITY

PROJECT NAME STE(A)M Learning Ecologies (SLEs)

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CONSORTIUM

- European Schoolnet (EUN Partnership AISBL), Belgium - Coordinator
- Agenzia per la Promozione della Ricerca Europea (APRE), Italy
- Center for the Promotion of Science (CPN), Serbia - Affiliated Entity
- Centro Ciência Viva do Algarve (CCVALG), Portugal - Affiliated Entity
- Ellinogermaniki Agogi (EA), Greece
- European Network Science Centres & Museums (ECSITE), Belgium
- Humboldt-Universität Zu Berlin (HUB), Germany
- Ministry for Education, Sport, Youth, Research and Innovations (DCM), Malta
- Museos Científicos Coruñeses (CASACIENCIAS), Spain - Affiliated Entity
- National University of Ireland Galway (NUIGALWAY) - Affiliated Entity
- Norwegian University of Science and Technology (NTNU)
- University of Cyprus (UCY), Cyprus
- WISTA, Germany

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WEBSITE

- <https://www.steamecologies.eu/>
- [SLES - STE\(A\)M Learning Ecologies \(scientix.eu\)](https://www.scientix.eu/)

FOR MORE INFORMATION

Contact the SLEs Coordinator at info-sles@eun.org

COLLABORATIONS

The SLEs project is part of the [Open Schooling together](#) (OStogether) network of projects and supported by the of [Scientix](#) community for science education in Europe.

FURTHER READING

- [SLEs Concept White Paper](#)
- [SLEs Methodology](#)
- [Open Schooling Policy Brief](#), Make it Open (MiO) and Schools as Living Labs (SALL) Horizon 2020 projects, with the support of the OStogether network.



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