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EUROPEAN

POLICYBRIEF

Surrounded by Science

THE ROAD TO A EUROPEAN ACCREDITATION SCHEME FOR INFORMAL OUT-OF-SCHOOL LEARNING

FIRST SURROUNDED BY SCIENCE POLICY BRIEF

31 March 2023

INTRODUCTION

While there has been significant attention given to the importance of science education in schools and higher education, there has been a lack of exploration into the nature and effects of informal science education and the impact of non-educational activities. The Internet has made it easier to acquire knowledge and evaluate it, and this trend should be recognized for its potential to create more informed consumers and enhance scientific citizenship. To better understand how science education outside the classroom affects citizens, it is important to evaluate what knowledge is accessible and being learned.

To address these gaps in knowledge, the Surrounded by Science project seeks to identify good practices in informal science education and assess their impact on formal and informal education for students and citizens in the short term. In the medium term, the project aims to enhance the EU's understanding of the effects of science education beyond traditional educational institutions and support the development of innovative science education products that meet societal needs. Ultimately, the research findings can contribute to discussions on accrediting available information in the long term.

EVIDENCE AND ANALYSIS

Europe has very ambitious goals for the next decades. It aims to reach climate neutrality by 2050[1] and lead a successful digital transformation by 2030.[2] For these goals to be realised, we need to adapt our education systems to catch up with a rapidly transforming technological and socio-economic reality and help close the skills gap that endangers the prospect of a green and digital future for the next generations of Europeans.

To this end, strengthening STEM (science, technology, engineering and mathematics) is one of the most important policy levers to equip future generations with 21st century skills. And while science is everywhere, underpinning every aspect of our lives, in 2015 the world-renowned PISA assessment found that almost one

[1] https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy_en
[2] https://digital-strategy.ec.europa.eu/en/policies/europes-digital-decade

in two students in the OECD countries were not able to complete even basic reading, mathematics or science tasks.[3]

As traditional STEM education is failing to provide students with the right skills to succeed in today's interconnected world, education experts are proposing new methods of teaching and engaging with students. Education pioneers and experts advocate for modern approaches to science and related subjects such as the use of "out-of-school science activities" to advance STEM education, both in Europe and across the oceans. This poses important and challenging questions on the current and future educational ecosystems and raises a collective societal need. In particular, concerns about frameworks, the role of teachers and the accreditation of informal scientific learning environments are key.

In this regard, the following questions guide the majority of ongoing European institutions, associations, organisations and a myriad of education-related stakeholders:

- How can our education systems become future-proof?
- What is the impact of "out-of-school science activities" *vis a vis* canonical school activities?
- What is the role of new accreditation methods in promoting scientific learning in informal environments?
- What frameworks and new methods work?
- And what can we do to scale them up and integrate them in education systems?

In order to address these challenges and reach the goals set, the Surrounded by Science project is divided into three phases. Phase 1 focuses mainly on the nature of out-of-school activities, produces an overview of the existing activity types, and defines their key characteristics and success criteria. The data collected stems from activity providers and participants, supported by literature. Phase 2 explores the effects of out-of-school activities, for which a selection of case studies (covering different activity types, domain areas and target groups) is made. Each case is studied from several perspectives, varying from context-oriented (e.g., looking into environmental characteristics of the activities and programmes) to person-oriented (e.g., looking into participant outcomes relating to the 6 strands of science proficiency). Phase 3 introduces self-assessment of out-of-school science activities and provides suggestions for their improvement.

Policy Implications and Recommendations

The policy implications of out-of-school STEM activities are wide-ranging and can have important implications for educational and economic outcomes. By promoting investment, equity, coordination, and evaluation in out-of-school STEM activities, policymakers can help to ensure that all young people have the opportunity to develop the skills and knowledge needed for success in STEM fields and beyond.

According to the research carried out in the first half of the project lifespan, the following policy implications and recommendations should be considered:

- Existing informal learning frameworks are not sufficient in addressing the fast-paced digital advancement of new media. Rethinking education in the digital age therefore matters for safeguarding European values such as equality, democracy and the rule of law.[4]
- The impact of out-of-school activities has several implications across different domains.
    - First and foremost, investment in STEM education has systematically increased in recent years and much more resources and initiatives are devoted to promoting collaboration and investment. One successful example is provided by the European Union's Horizon 2020 programme and the European STEM Schools Support. When considering support and access, it is important to note that policymakers can play a role in ensuring that all young people have access to high-quality out-of-school STEM activities, regardless of their background or socioeconomic status.
    - Secondly, there is increasing awareness around the gender gap persistent in STEM domains. For example, a report published by UNESCO in 2017 found that women are significantly underrepresented in STEM fields worldwide, and that this gender gap is particularly pronounced in developing countries. Specifically, it found that in higher education, only 35% of all students enrolled in STEM-related fields are female. Today, only 28% of all of the world's researchers are

[3] OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*, PISA, OECD Publishing, Paris, https://doi.org/10.1787/9789264266490-en.
[4] https://www.europarl.europa.eu/RegData/etudes/STUD/2020/641528/EPRS_STU(2020)641528_EN.pdf.

women.[5] As a result, several campaigns, programmes and various initiatives have been established in order to bridge the gender gap in STEM. Examples include the European Commission work on addressing the under-representation of women in STEM fields through a roadmap of activities, including a manifesto on gender-inclusive STE(A)M education and careers. Other pioneering EU-funded projects supporting the goal of gender equality and inclusiveness in STEM include Scientix 4- Inquiry-based science education in Europe, coordinated by European Schoolnet (EUN) in Belgium; CALIPER - Linking research and innovation for gender equality, coordinated by ViLabs OE in Greece.[6]

  - Third, in order to maximise the impact of out-of-school STEM activities, it is important to promote coordination and collaboration among stakeholders, including programme providers, educators, policymakers, and industry partners. This is one area in which Surrounded by Science, as well as its so-called “sister projects” can potentially be of great interest to the audience. Altogether, they can contribute to broader educational and economic development goals.
  - Last but not least, evaluation and accountability need to be discussed. Also in this area, the Surrounded by Science project promises to deliver tangible results, setting standards for programme quality based on extensive research.
- Design and deploy accreditation frameworks and ways to scale them up and broadly integrate them into educational systems, nationally and locally. Examples are the EUR-ACE, a framework and accreditation system that provides a set of standards that identifies high-quality engineering degree programmes in Europe and abroad; and ASIIN - the Accreditation Agency for Study Programmes in Engineering, Informatics, Natural Sciences and Mathematics.

SUSTAINABILITY AND LEGACY

The project is developing an exploitation and sustainability plan in the form of a living document that outlines the valuable material and results of the project, featuring a mapping of existing networks and communities where exploitation can take place. This tool will be regularly updated by partners and exploitation will be a feature of each project meeting. Specifically, the exploitation and sustainability activities of the project takes place along four main steps:

1) The definition of the exploitable assets of the project;
2) The assessment of stakeholders’ needs, specifically for what concerns public administrations;
3) Benchmarking the exploitable assets with target stakeholders in order to identify suitable exploitation and sustainability strategies;
4) Devise a vision for future research in the fields as well as for the development of commercial products.

The exploitable assets identified in the project are as follows:

- *Surrounded by Science matrices*: the tool is used for assessing the impact of out-of-school science learning activities and can serve as a basis for a competency-based approach for the accreditation of out-of-school learning activities;
- *Science Booster*: it makes science organisations aware of the impact that their activities have on different target groups and to provide them with targeted input for improvement;
- *Science Chaser App*: it monitors how learners use science-related activities, provides recommendations for future/related actions and collects user data to receive a more in-depth understanding about the users, their interests and engagement in science-related activities, resulting in user profiles;
- *Surrounded by Science Roadmap for Designing Effective Out-of-School Science Activities*: the accreditation and certification system recommendations proposed within the scope of the project can be used by education institutions to accredit and certify science learning activities that originate outside the school science system. The roadmap will highlight three innovations (that form the conceptual framework of the project) that may change the future of assessment in this sector: a) the development of shared instruments to assess common outcomes; b) advances in instrumentation that support unobtrusive data collection and analysis; and c) the growing awareness and use of the concept of “learning ecologies”.

[5] *Chavatzia, Theophania. “Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM).” (2017).*

[6] European Commission, Directorate-General for Research and Innovation, Bridging the gender gap in STEM : strengthening opportunities for women in research and innovation, Publications Office of the European Union, 2022.

Research Parameters

The aim of the Surrounded by Science project is to gain understanding of the effect of out-of-school science activities by developing and implementing a methodology for the assessment of these activities. The results of the process will provide insights in the strengths and weaknesses of different out-of-school science activities in various contexts. The results will indicate which effects are met by out-of-school activities that are hard to obtain in traditional school-based science education and may serve as a reference point for informing educational policies in the field.

In order to identify good practices outside the classroom, an overview of types of out-of-school science activities was created. The assessment was based on interviews with 219 stakeholders among activity providers, schoolteachers, and visitors and participants to out-of-school science activities, ranging from 20 different countries. Additionally, a scan of repositories of the most recent and innovative European projects that looked at the development of out-of-school science activities in Europe was conducted.
In total, 14 activity types were identified. They are categorised according to the three learning contexts of designed environments, outreach programmes, and media- and technology products defined in the project context. For each activity type, key design characteristics and success criteria were identified. The identified activity types and their key design characteristics were used as inputs for the matrices defined in work package 2. In addition, an inventory of existing out-of-school science activities was made, The creation of this inventory was essential in mapping the existing ecosystem of activities and to provide insight into the approaches that organisations in Europe are taking to engage with visitors and attract their interest while stimulating their curiosity. The inventory and overview of activity types were based on dialogues with 51 activity providers from nine different countries. The inventory consisted of 76 activities from which 18 case studies were selected for further research.

Inspired by Sinatra and colleagues' grain-size continuum of measurements of engagement in science learning[7], three different research perspectives have been taken to investigate the impact of the selected case studies. One perspective focuses more on the characteristics of the activity that trigger attention and interaction, whereas others focus more on visitor's experiences, learning outcomes, or individual learning paths they take. As such, one of the main goals of the project is to provide an evidence-based understanding of the key but yet under-researched role of out-of-school STEM learning activities benchmarked against the Six Strands of Science Proficiency[8] (i.e., outcomes involving interest and engagement, science knowledge, scientific reasoning, reflecting on science, engaging in the tools and language of science, and science identity). Assessment instruments have been selected and developed for each of these six strands in the three research perspectives. These instruments are used in the research within the case studies. The resulting knowledge will help in identifying good practices, as well as in designing them. This will be input for the to-be-developed Science Booster. In addition, the instruments used are also input for the Science Chaser, an innovative app which aims at measuring and monitoring users' science-related activities and making recommendations for related additional activities.

Project Identity

Project name	Surrounded by Science: Learning paths towards science proficiency (SURROUNDEDbySCIENCE)
Coordinator	UNIVERSITEIT TWENTE (UT), established in DRIENERLOLAAN 5, ENSCHEDE 7522 NB, Netherlands. Tessa Eysink, t.h.s.eysink@utwente.nl
Consortium	ELLINOGERMANIKI AGOGI SCHOLI PANAGEA SAVVA AE – EA – Pallini, Greece EUROPEAN PHYSICAL SOCIETY ASSOCIATION – EPS – Mulhouse, France

[7] Gale M. Sinatra, Benjamin C. Heddy & Doug Lombardi (2015), *The Challenges of Defining and Measuring Student Engagement in Science*, Educational Psychologist, 50:1, 1-13, DOI: 10.1080/00461520.2014.1002924.
[8] National Research Council. 2009. *Learning Science in Informal Environments: People, Places, and Pursuits*. Washington, DC: The National Academies Press. https://doi.org/10.17226/12190.

	NUCLIO NUCLEO INTERACTIVO DE ASTRONOMIA ASSOCIACAO – NUCLIO – Sao Domingos de Rana, Portugal Fondazione IDIS-Città della Scienza - IDIS – Napoli, Italy THE LISBON COUNCIL FOR ECONOMIC COMPETITIVENESS ASBL – LC – Bruxelles, Belgium WEIZMANN INSTITUTE OF SCIENCE – WIS- Rehovot, Israel NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET NTNU – NTNU – Trondheim, Norway
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BUDGET	EU contribution: 1.897.600,00.€.
WEBSITE	https://surroundedby.science
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FURTHER READING	

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