

Deliverable 2.2

STEAM educational and methodological blueprint



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Abstract	This document will present the comprehensive educational strategy that will serve as the project's pedagogical cornerstone, underpinning all subsequent development and activities. The blueprint is as a detailed instructional guide, that will integrate the core principles of STEAM into a cohesive educational experience, with emphasis to be given to the 'arts' education part.
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Table of contents

1	Introduction.....	4
1.1	Purpose of the document	4
1.2	STEAM Innovation aims	4
1.3	The rationale of the ‘STEAM Innovation’ project	4
2	STEAM in Education	6
2.1	Need for STEAM approaches	6
2.2	Countries Needs: A participatory approach	8
2.3	The STEAM Innovation Concept	10
3	The STEAM Innovation Approach and Methodology.....	12
3.1	The Methodology.....	12
3.2	The Approach.....	12
4	The STEAM Innovation Support Material Structure.....	15
4.1	Material Structure.....	15
4.2	Learning science through music	16
4.3	Learning Science Through Theater	20
4.4	Students as Change Makers.....	27
5	Conclusions.....	36

1 Introduction

1.1 Purpose of the document

This document will present the comprehensive educational strategy that will serve as the project's pedagogical cornerstone, underpinning all subsequent development and activities. The blueprint is as a detailed instructional guide, that will integrate the core principles of STEAM into a cohesive educational experience, with emphasis to be given to the 'arts' education part. It outlines the pedagogical approaches (e.g., inquiry-based learning), design thinking methodologies, learning objectives, and assessment methods, ensuring they are in alignment with the latest educational standards and are adaptable to the needs of a diverse student body. Also, this task involves synthesizing the insights gained from the D2.1 reports (i.e., local forums and expert consultations) to construct a curriculum that is academically robust and resonates with the students' lived experiences and sparks their curiosity. It includes strategies for implementing the curriculum in various non formal educational settings and contexts. There are included specific sections on how STEM will be meaningful integrated in theatre, music, and making and tinkering.

1.2 STEAM Innovation aims

STEAM Innovation recognizes the unique interconnection of science, heritage, culture, and arts. Within this context, environmental issues can be also addressed, encouraging students to think critically about how they can contribute to sustainable development through their artistic and scientific endeavours and improve their green competence profile. Thus, the project envisages **using the arts as a medium to articulate complex scientific concepts, particularly those relating to environmental stewardship (Chapin et al., 2010) and climate change.** The project will empower participants, especially those from marginalized backgrounds, students with fewer opportunities to learning, and underrepresented groups in the STEM sector, by giving them a platform to express their unique cultural identities and perspectives. This expression through creative STEAM activities will assist in breaking down barriers, challenging stereotypes, and enhancing a sense of belonging and community. Furthermore, the project aims to transform the role of student in the learning process, shifting from passive recipients to active creators of knowledge. Through mentorship and collaboration with professionals across various fields, young learners will gain practical insights and develop solutions that integrate scientific understanding with artistic practice. The STEAM Innovation project aligns with EU priorities and the UN SDGs, focusing primarily on social inclusion, sustainability (i.e., environmental stewardship, and climate action), as well as on digital literacy. This strategic focus on systemic change will stimulate diverse participation and collaboration, endorsing new business models within sustainable cultural heritage and leveraging cultural and environmental assets.

1.3 The rationale of the 'STEAM Innovation' project

Within the conceptual framework of the STEAM Innovation project, the synthesis of artistic practice and scientific inquiry emerges as an innovative approach to education and a contributor to cultural understanding and peace.

The project aims to create an environment where young learners, specifically those in the age groups of upper primary (9-12 years) and secondary (13-18 years) education, immerse themselves in the methodologies of science while simultaneously exploring the rich tapestry of artistic expression. This approach will be enriched by integrating elements of cultural heritage, encouraging a dialogical relationship among these traditionally disparate disciplines. The inclusion of cultural heritage in STEAM learning, has the potential to deepen the learners' understanding and appreciation of their own and others' cultures but also provides a contextual backdrop, enhancing the interconnectedness of science, arts, and human history. This holistic educational model is designed to cultivate critical thinking,

creativity, and a profound respect for cultural diversity, equipping students to contribute thoughtfully to the global community.

Specifically, the document presents a pedagogical framework that will lead to an educational program (D2.3) that will facilitate the articulation of scientific phenomena through artistic mediums and methods, such as theatrical dramatization, musical composition, and the development of artistic crafts through making and tinkering processes in Makerspaces. Based on the STEAM Innovation framework, this document, the educational program (D2.3) will be particularly invested in the hands-on production of novel artistic artifacts and artworks by students, which can be showcased within local communities, and transnationally, thereby fostering a tangible connection between the learners' creations and their cultural environment.

music	Students study scientific themes like acoustic ecology and the physics of sound, exploring how environmental changes affect natural soundscapes or the science behind musical instruments of different cultures. This leads to creating musical pieces or sound installations that embody their findings, merging artistic expression with scientific exploration. Students could, for example, compose a piece interpreting climate change data, using elements like tempo and harmony to represent environmental shifts, thus contributing to cultural awareness and the music industry.
theatre	Theatre serves as a storytelling platform, effectively conveying scientific concepts. Students can craft plays that dramatize scientific phenomena or technology's societal impact, incorporating cultural narratives and ethical dilemmas. Through scriptwriting and stagecraft, they deepen their topic understanding while honing skills in communication and creative thinking, potentially influencing the theatre industry with fresh, culturally rich, content.
making & tinkering	In makerspace environments, hands-on learning allows students to use making and tinkering as tools for STEM innovation. Projects might range from building sustainable city models to designing robots for environmental cleanup, often drawing inspiration from cultural heritage and traditional techniques. These activities can bring STEM concepts to life and offer potential prototypes and innovations for creative industries.

2 STEAM in Education

2.1 Need for STEAM approaches

STEAM education is a transdisciplinary approach to learning that integrates Science, Technology, Engineering, the Arts, and Mathematics. It evolved from STEM education, which initially focused on science, technology, engineering, and mathematics, but later incorporated the arts to emphasize creativity, design thinking, and innovation. The inclusion of the arts helps students develop a more holistic understanding of problem-solving and critical thinking, making STEAM a well-rounded educational framework.

The background of STEAM education is rooted in the recognition that real-world problems require transdisciplinary solutions. Traditional education models often separated subjects into distinct categories, but STEAM encourages students to apply knowledge from multiple fields to address challenges creatively. This shift aligns with the demands of the modern workforce, where industries increasingly seek employees who can think critically, collaborate across disciplines, and innovate.

According to the recent communication of the European Commission (EC), [“A STEAM Education Strategic Plan” \(2025\)](#) *“While education and training systems have already taken steps to raise awareness and support actions to improve STEM skills, including through cooperation in the context of the European Education Area, **stronger focus on STEM education and training is essential to sustain competitiveness, preparedness and technological leadership**”*. In this Communication the EC emphasise to the need of teachers’ professional development by identifying this factor as one of the most crucial in order to **address the challenges in school STEM education which requires improving curricula, making them more engaging to spark interest in STEM subjects, and promoting innovative teaching methods**. Based on the Strategic Plan, *this includes project-based learning, which encourage students to apply theoretical knowledge to real-world-scenarios and transdisciplinary education and training, that promotes creativity and increases student engagement*. However, as it states, **teachers face insufficient professional development support, especially for addressing low achievement of students**.

Moreover, as suggested from several reports, STEAM education could be particularly beneficial in promoting equity in learning (e.g., Castek, J. et al (2019)¹, [Road STEAMer Framework](#)). By presenting STEM subjects in a more accessible and engaging way, it helps bridge gaps for students who may not initially be drawn to science or math. This inclusivity is especially important in addressing gender disparities and encouraging underrepresented groups to pursue careers in STEM-related fields.

Developing key competences and skills (basic skills of maths and science but also digital skills, entrepreneurship, citizenship, intercultural skills, critical thinking, collaborative problem solving and creativity) for all is at the heart of the **European Education Area** which is a space where everyone should receive the best education, training and lifelong learning. In today's world, young people need a broad set of competences and skills to find fulfilling jobs and become independent, engaged and responsible citizens. To achieve these objectives, we need to ensure relevant and meaningful engagement of all societal actors with science and increase the uptake of science studies and science-based careers, employability and competitiveness. STEAM education seems to be an effective vehicle for such a new participatory reengineering of schooling and has gained increasing attention worldwide as a transdisciplinary approach that fosters critical thinking, creativity, problem-solving, and

¹ Castek, J., Schira Hagerman, M., and Woodard, R. (Eds). (2019). Principles for Equity-centered design of STEAM learning-through-making. Tucson: University of Arizona. Retrieved from <https://circlcenter.org/events/synthesis-design-workshops>

innovation. By integrating the arts into STEM disciplines, STEAM encourages holistic learning experiences that bridge scientific knowledge with creative and human-centered solutions.

Europe stands at a critical connection in rethinking education and cultural participation to equip its citizens with the competences needed for an increasingly complex, interconnected, and rapidly evolving world. Among the most urgent challenges is the need to integrate STEM education with the Arts—an approach widely referred to as STEAM—which promotes interdisciplinary learning, creativity, and cultural awareness. The [European Education and Training Monitor 2020](#) highlights a growing mismatch between educational provision and the demands of the digital and green transitions, calling for reforms that nurture transversal skills, innovation, and inclusive participation (European Commission, 2020). Despite numerous national and European efforts, significant disparities persist across EU member states in students' access to high-quality STEM education, particularly when it comes to engagement with creative, interdisciplinary, and socially relevant content. These disparities are impaired by socio-economic inequalities, gender gaps, rural-urban divides, and unequal access to cultural opportunities. Girls and young people from disadvantaged backgrounds remain underrepresented in both STEM pathways and artistic activities, hindering the EU's objectives for equality, inclusion, and innovation ([OECD, 2023](#); [EIGE, 2023](#)). Moreover, most existing educational models continue to operate in disciplinary silos, limiting learners' ability to synthesise knowledge across domains and to understand the broader societal, environmental, and cultural relevance of scientific inquiry. As pointed out by Quigley and Herro (2016), while STEM education equips learners with core technical skills, the integration of the Arts introduces interpretive, empathetic, and reflective capacities that are essential for solving real-world challenges. This is especially pertinent in addressing contemporary issues such as climate change, mental health, digital ethics, and social fragmentation; issues that require not only scientific knowledge but also imagination, critical thinking, and civic engagement. Parallel to the education system, the cultural and creative sectors (CCS) are also undergoing a profound transformation. As outlined in the *New European Agenda for Culture* and the *New European Bauhaus* initiative, there is a growing recognition of culture's role in advancing sustainability, resilience, and democratic participation. However, the ability of cultural organisations to contribute to these goals is often hampered by a lack of interdisciplinary frameworks, insufficient youth engagement, and inadequate collaboration with schools and local communities. According to the [Council Work Plan for Culture 2023–2026](#), more needs to be done to promote cultural participation, especially for young people, by creating new models of collaboration between the education and culture sectors.

At the **European level**, the OECD's [Fostering Students' Creativity and Critical Thinking](#) report provides a framework to help teachers integrate these skills into the curriculum. However, many educators feel unprepared due to the lack of a shared professional understanding of how creativity and critical thinking manifest in formal education. STEAM education addresses this gap but remains underutilised. Some fear that emphasising creativity and critical thinking may detract from core subject knowledge, yet STEAM's interdisciplinary, hands-on methods reinforce both. Others worry about time constraints and disruptions to traditional structures, but STEAM inherently supports adaptable, inquiry-driven learning. According to the recent published EC's Communication "[A STEM Education Strategic Plan](#)", a key barrier is the absence of clear models, making implementation difficult. Based on the recommendations of the Strategic Plan, embedding STEAM principles—problem-solving, experimentation, collaboration—into daily teaching can bridge this gap. Across Europe, STEAM integration varies due to differing policies, infrastructures, and teacher readiness. Many countries lack standardized approaches, with rigid subject structures limiting transdisciplinary learning. Gender disparities persist, especially in engineering and technology, requiring inclusive education strategies. Real-world applications are needed to boost student interest in STEAM fields.

2.2 Countries Needs: A participatory approach

The STEAM Innovation project has identified specific needs that should be covered in the participating countries. This identification led the project partners to propose a specific methodology and a framework in which specific practices will be realised.

The project followed a participatory methodology involving and engaging relevant stakeholders in Greece, Cyprus, Italy and Portugal. Specific workshops were organised from December 2024 until April 2025 with teachers, students, school heads, parents, experts on educational methodologies, researchers and Cultural & Creative Industry (CCI) representatives.

The consortium partners organised 2 set of workshops in each country (Greece, Cyprus, Italy and Portugal):

1. Local forums formation and consultation

This involved the strategic formation of local forums consisting of key educational stakeholders, including school administrators, teachers, students, and parents. The purpose of these forums was to facilitate a consultative process that grounds the STEAM Innovation project in the needs and aspirations of local communities. As part of this community building effort, educators worked together and exchange good practices, while members of the school and local communities had an active involvement through the use of the Design Thinking Methodology. **Focus groups were organized (in total 5) inviting relevant stakeholders (in total 69)** to voice their perceptions of local educational challenges, to pinpoint the opportunities that exist within the STEAM fields and exchange ideas. Based on the data gathered, each partner developed a national report.

2. Consultation with experts in science, arts and CCIs

Each partner organized a local session/meeting with experts in science, arts and CCIs and representatives from local cultural and scientific institutions (**in total there were organised 4 sessions engaging 57 experts**). These sessions extracted valuable insights on current educational practices, innovative pedagogical methods, and future trends in STEAM education. The involvement of experts from varied disciplines helped to ensure that the educational framework that will be developed by the project is scientifically rigorous and creatively stimulating and culturally relevant. Each partner developed a report.

The results from the above-mentioned activities are presented in D2.1 which can be found [here](#).

The participatory methodology adopted by the STEAM Innovation project—combining Local Forums and Expert Groups—proved highly effective in capturing a comprehensive, multi-perspective understanding of STEAM education. By engaging students, teachers, parents, school leaders, and professionals across the arts, sciences, and education sectors, the project fostered inclusive dialogue and co-creation. Local Forums enabled grassroots voices to surface everyday challenges and aspirations, while Expert Groups contributed strategic insights, innovative practices, and future-oriented thinking. This dual approach ensured that proposed solutions were both grounded in lived experience and informed by cutting-edge expertise, leading to more relevant, equitable, and actionable outcomes for STEAM education policy and practice.

The main needs concerning STEAM approaches, as identified by the relevant stakeholders in each country, are the following:

Greece

Based on the findings from the STEAM Innovation Local and Experts Forums in Greece, there is a clear and growing need for systemic implementation of STEAM approaches within formal education. Current efforts are largely driven by extracurricular initiatives and individual educators, highlighting the urgent demand for curriculum reform, structured teacher training, and sustainable integration of

interdisciplinary, experiential learning. While innovative practices like arts-science collaborations (e.g., Learning Science Through Theater), digital technologies, and community partnerships are emerging, barriers such as unequal access, fragmented implementation, inadequate assessment tools, and institutional resistance persist. Addressing these challenges requires coordinated support from educational authorities, the integration of cultural and scientific institutions, and the development of inclusive, ethical, and sustainability-focused learning environments that empower both educators and students across urban and rural settings.

Cyprus

The findings from the STEAM Innovation Local and Experts Forums in Cyprus highlight an urgent need to formally embed STEAM approaches into the national education system. While creative and impactful interdisciplinary practices exist—such as project-based learning, science theatre, and collaborations with the cultural sector—these remain largely extracurricular or pilot efforts. Structural barriers, including rigid curricula, limited teacher training, and lack of resources, hinder broader implementation. Both forums stressed that STEAM education is essential for equipping students with future-oriented skills like creativity, problem-solving, and innovation. Equitable access, especially for marginalized communities, was emphasized as a key priority, alongside the ethical integration of emerging technologies like AI and VR. There is a clear call for systemic reforms: professional development for educators, cross-sector collaborations, inclusive and flexible curricula, and national policies that recognize STEAM as a foundational pillar for education aligned with EU digital and green transition goals.

Italy

The findings from the STEAM Innovation Local and Experts Forums in Italy reveal a clear and growing need to systemically embed STEAM approaches into the national education framework. Despite a diversity of successful practices—such as interdisciplinary projects, cultural collaborations, and tech-integrated learning—STEAM remains insufficiently incorporated into core curricula. Participants highlighted widespread challenges, including lack of teacher training, rigid educational structures, outdated infrastructure, and inadequate assessment tools for interdisciplinary competencies. There is consensus that STEAM can enhance creativity, critical thinking, socio-emotional skills, and student motivation, particularly through collaboration with cultural and scientific institutions. However, successful implementation demands strategic support: professional development, policy alignment, inclusive curricula, and increased funding. Students and educators alike emphasized the transformative potential of real-world, project-based STEAM learning—especially when rooted in equity, innovation, and community engagement.

Portugal

The STEAM Innovation Local and Experts Forums in Portugal revealed a broad consensus on the transformative potential of STEAM education, particularly in fostering creativity, problem-solving, and interdisciplinary thinking. All stakeholders—students, parents, educators, and professionals—recognized the value of STEAM in connecting learning to real-world contexts and future careers. However, diverging views emerged around implementation strategies, assessment reforms, and resource prioritization. Key barriers include insufficient teacher training, outdated infrastructure, resistance to change, and weak collaboration between schools, families, and industry.

Both forums underscored the need for inclusive, project-based, and emotionally engaging learning experiences that integrate technology and the arts. The Experts Forum especially emphasized the importance of visualization, storytelling, and emotional engagement in making STEM accessible, while warning of the risks of automation and the need to retain human creativity.

Opportunities lie in closer collaboration with industry, redefining assessment practices, expanding teacher support, and fostering STEAM career pathways. To achieve this, stakeholders called for targeted policies, strategic investments, and the active involvement of external partners. If these conditions are met, STEAM education in Portugal can become a powerful driver of educational innovation, equity, and societal relevance.

2.3 The STEAM Innovation Concept

In the framework of the project, we are aiming to initiate an informed debate regarding collaboration between Art and STEM at curricular level in schools in order to also respond to the expressed needs.

Today, the disciplines continue to be perceived as intrinsically different and separate, both pedagogically and culturally. In STEAM Innovation we will **combine Science with Arts** and assess it through the proposed approach, which **pushes the boundaries of subject interconnection in schools**, while simultaneously providing a vehicle for creative STEM education, the acquisition of skills and opening new spaces for genuine enjoyment while learning. In fact, there is an unparalleled level of connection between these two disciplines. As Wenham (1998, pg.61) states, “there is and always has been significant common ground between art and science, encompassing not only issues of mutual concern but also modes of enquiry.” If we accept that artists and scientists (amongst others) are searching for understanding and meaning, then this is our first common bond between the two disciplines, and our starting point. Deckert (2001, pg.125) says science is “usually seen as rational and analytical and art often considered subjective and emotional.” With perceptions of art and science so diametrically opposed in our society, it is necessary to be clear about their commonalities and where opportunities for meaningful collaboration exist.

Prior to designing and developing such an experiment, we have identified five main categories of commonality between STEM and Art. This is essential to ensure authenticity in our approach and appropriate justification for implementing the project in and with schools. The five categories are: modes of inquiry; fields of study; experimentation; creativity and imagination; aesthetic experience and artistic attitude. The STEAM Innovation approach brings together all these characteristics in an integrated activity in a way which constitutes a natural learning environment for young students.

STEAM should be used as a mean to support students to better understand concepts and processes. It provides multiple alternatives for problem-solving while exploring multiple modes of inquiry. **STEAM, as an integrator of different fields of study**, from different grade levels and multiple expertise areas, largely benefits from artistic views of specific models while freely embracing students’ preconceived imagination and enabling their own creativity while experimenting with their own research and ideas.

STEAM Innovation will put forward the adoption of a STEAM curriculum that requires a shift in the paradigm of national policies in schools in the involved countries. It requires the implementation of a deep structural and organizational change encompassing the design of a roadmap towards STEAM as a model for science education. It requires several steps in different levels:

- School level: Understand the school culture and infrastructure as well as the local community environment, its strengths and opportunities, existing obstacles and threats,

- Classroom level: Particularize findings to each grade level taking into consideration the specific needs of each age group of students,
- Teacher's level: Teachers from the different disciplines involved in each level should have the opportunity to participate in team-building activities, while significant professional development support (culture of cooperation, innovative pedagogical approaches, ICT skills) is needed,
- Student's level: provide multiple opportunities for self-development of each student by enabling autonomous creation of their own journey

A specific curriculum encompassing these items can then be designed.

- a) Start by focusing on the integration of the science subjects into a STEAM approach by using the Big Ideas of Science approach (Based on the document "Working with Big Ideas of Science Education", edited by Wynne Harlen in 2015)².
- b) Foster horizontal, vertical and diagonal collaboration between teachers (different subjects and grade levels, including collaboration opportunities in the same subject domain and throughout different subject domains),
- c) Aiming for deeper learning by following the five main categories of commonality between STEM and Art,
- d) Contextualize students' learning experiences and localize them by integrating examples from within the school community that can be addressed, studied, explored in the framework of projects.
- e) Create the context for students' creativity to emerge by offering opportunities to further develop their ideas providing enough freedom for them to explore their vision on certain topics, learn by trying to materialize their own theories and foreseen solutions with the inclusion of artistic expression.

The STEAM Innovation concept is envisioning STEAM as an aggregator of topics that are delivered to students in an interdisciplinary and contextualized format using a strong visual and artistic component will promote a much deeper understanding of the project/problem being addressed by students. The whole process needs to be facilitated and accompanied by teachers that must assume the role of travel companions. All subjects must be aggregated under a project umbrella and curriculum content delivered in an interdisciplinary and relevant way. The use of the STEAM approach will ensure not only the acquisition of the specific skills but also the increase understanding of all the relevant content knowledge and a much more effective practice. The methodology does not impose an increase in classroom time, on the contrary. If teachers work as a team and operate in a coherent way lots of time can be saved. The experience will facilitate a deeper learning for students involved and a much more meaningful teaching experience for the teachers as well. The STEAM Innovation will aim to integrate and demonstrate three main components for the successful development of STEAM curricula:

- Alignment with local, regional initiatives and national strategies and objectives with special focus on multidisciplinary learning and project-based approach;
- Curricula reform for STEM with a STEAM approach including real-world applications, inquiry-based and ICT-enriched learning, collaborative practices, with a whole school approach focus and the use of extra-curricular activities in order to deliver the wider range of skills that drive innovation and creativity and nurture forward-looking skills, including entrepreneurship skills;
- Focus on innovative teachers' professional development programmes in related pedagogies with multidisciplinary approaches.

² <https://www.interacademies.org/26703/Working-with-Big-Ideas-of-Science-Education>

3 The STEAM Innovation Approach and Methodology

3.1 The Methodology

The project is focusing on Learning STEM Through specific art-based methodologies namely music, theater and making & tinkering. STEAM Innovation has structured an approach that will be based on the following elements (also see Figure 1):

1. The Pedagogical approach will be based on the Inquiry-based learning model that will be integrated with the Design Thinking Approach
2. The project will focus on an Incubator methodology that will include training, creation, mentorship, and dissemination of students' artistic products.
3. Student projects will give emphasis on sustainability and an appreciation to cultural heritage.
4. The STEAM Innovation approach will be Intercultural & inclusive and at the same time will support the digital transition of CCI.
5. The approach is targeting to provide the involved stakeholders with the tools to develop their creative, critical thinking, problem-solving, green and digital competences

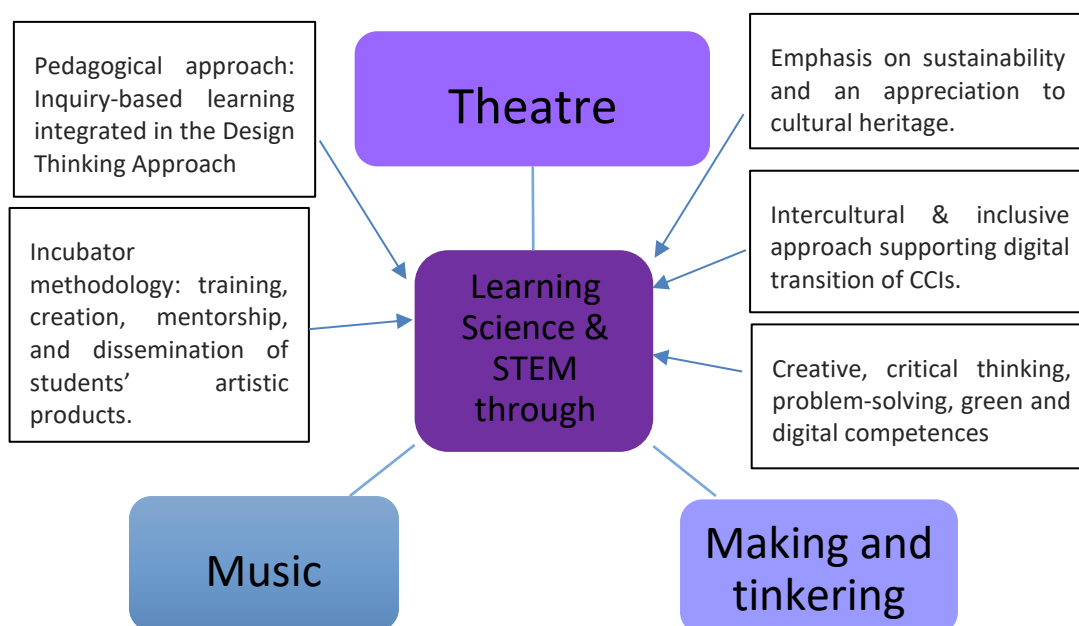


Figure 1: The STEAM Innovation methodology.

3.2 The Approach

To reach the full potential of the above-mentioned pedagogical principles and needs, the STEAM Innovation project will use the **Design Thinking methodology** bringing innovative and entrepreneurial aspects into the science and art disciplines with an "ideas become reality" mindset (into formal, informal and non-formal settings). **Design Thinking is a design methodology that provides a solution-based approach to solving problems.** It is useful in tackling complex problems that are unknown, by understanding the human needs involved, by re-framing the problem in human-centric ways, by creating many ideas in brainstorming sessions, and by adopting a hands-on approach in prototyping and testing. Design Thinking is in line with the proposed steps that STEAM Innovation will follow during the project, which are inspired by the [OSOS Open Schooling Model](#), namely **Feel, Imagine, Create** and

Share. They are in alignment with the Discover, Define, Develop and Deliver steps of the Double Diamond model of Design Thinking (see Figure 2).

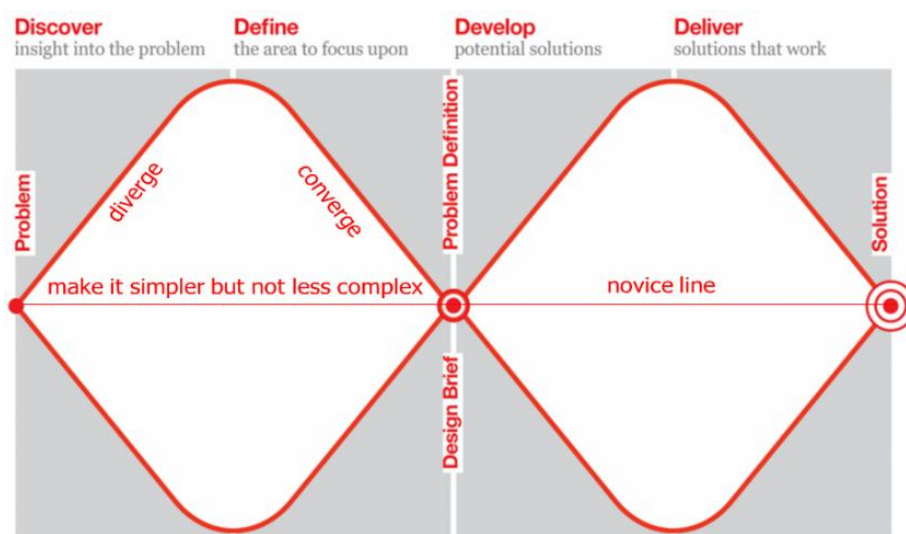


Figure 2: *The Double Diamond model of the British Design Council³*

STEAM Innovation will act as a facility, as a meeting place. It's a place between science, art and the society to connect all the stakeholders and draw ideas that will be realized with a common purpose, the well-being of the local/national/international community. It will **FEEL** societal needs, will explore and **IMAGINE** novel solutions for the future so to **CREATE** these within the school and **SHARE** it with the community. It's a facility designed to generate new ideas in an open and collaborative environment, to promote experimental innovation and rapid prototyping for art/science-related projects.

³ Design Council, figure retrieved in September 2019 from <https://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond>

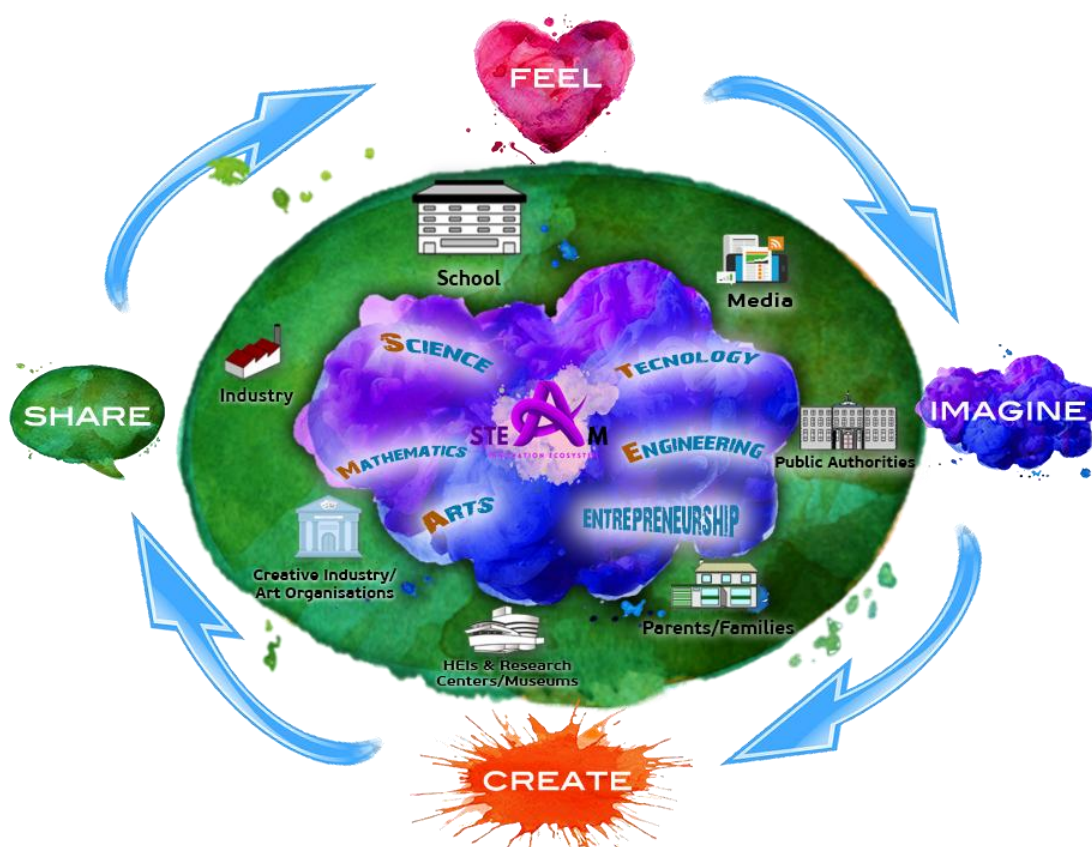


Figure 3: The STEAM Innovation Approach. Each school will follow the respective **guidelines and material according to the setting in which it is operating**. Specific scenarios of use, will be provided by the **STEAM Innovation partners (through the material that will be developed – see examples in section 4)** in order to show case how the proposed initiative could be realized and at the same time a **support mechanism** will be provided by the project partners in order to support all the needed implementation activities. The schools will collaborate with **each other as well as with Stakeholders during the implementation phase** in order to identify the local/national/international needs and develop their own real-life STEAM projects to provide solutions **through the development of music, theater and making & tinkering activities**. The latter will follow the **Feel, Imagine, Create and Share** approach (integrating design thinking and inquiry-based learning elements).

The above-mentioned model guides students to develop their projects following the updated four - phase process:

- **FEEL:** Students identify problems in their classrooms, schools, and communities. Students observe problems and try to engage with those who are affected, discuss their thoughts in groups, and vote on ideas.
- **IMAGINE:** Students envision and develop creative solutions that can be replicated easily, reach the maximum number of people, generate change, and make a quick impact.
- **CREATE:** Students collaborate in classroom in order to develop a plan of action to effect change. This includes planning, implementing, and later recording the process.
- **SHARE:** Students submit their work to STEAM Innovation through the development of specific artifacts (e.g., theater performances, music compositions) in order to be assessed and be awarded for the final festival of the project. At local level they could share their work with their classmates and students of the school, as well as with parents and external stakeholders and are encouraged to do so with other schools in the community and local media.

4 The STEAM Innovation Support Material Structure

4.1 Material Structure

STEAM Innovation partnership will support the involved students and teachers by providing already existing material and scenarios that could be used within their settings. These materials are following the design thinking approach integrating the inquiry-based learning model and give all the needed information to the user in order to implement activities and/or adapt them. Also, they will be able to develop their own activities with the support of the partners, in each country, through the mentorship scheme that will be followed.

STEAM Innovation has developed a template in order to follow the same structure in each one of the cases (music, theater, making & tinkering). Below is presented the template and its structure. In the next section we present one example activity for each one of the cases.

Activity Description

Name of the Activity

(WP2)

4.1. Description

1.1. Introduction

1.2. Learning Objectives

1.3. Available partnership opportunities

Here are some partnership opportunities you should consider in your development:

Stakeholder	Partnership description/Contribution
Parents	
Local businesses	
Local authorities	
NGOs	
Artists	
Researches	
Research institutes	

1.4. Recommended resources

1.5. AGE OF STUDENTS INVOLVED

1.6. SUBJECTS DOMAIN

2. Implementing the Activity following the Design Thinking Approach

	Phase I – Question
FEEL <i>What is the problem demanding action from the schools</i>	Phase II – Evidence
IMAGINE <i>How could the schools – students act up? What partnerships are required?</i>	Phase III – Analyze Phase IV – Explain
CREATE <i>Describe the activities</i>	Phase V – Connect
SHARE <i>How do you plan to share the outcomes of your activities and build new partnerships?</i>	Phase VI – Communication Phase VII – Reflection

4.2 Learning science through music

1. Description

1.1. Introduction

In this activity, students explore scientific concepts through music composition and/or instrument creation, and performance, merging artistic expression with scientific inquiry. The activity aims to facilitate a deeper understanding of science through the lens of sound and music, while enhancing students' creativity and engagement. Students investigate phenomena from science, technology, engineering, and mathematics (STEM) and translate them into musical representations or functional instruments. This interdisciplinary approach promotes knowledge acquisition, skill development, and values such as collaboration, innovation, and sustainability.

1.2. Learning Objectives

The main objectives of the proposed activity are grouped into three categories:

Knowledge acquisition

- Explain the fundamental scientific principles relevant to selected themes (e.g. waves, sound, ecosystems).
- Explore and describe how sound is generated, transmitted, and perceived.
- Summarize the basic musical theory, including rhythm, melody, and harmony.
- Identify and explain how scientific phenomena can be represented through musical elements.
- Give examples of different families of musical instruments and the science behind their structure and function.

Competence development

- Formulate scientific questions and conduct guided research.
- Apply scientific knowledge in designing musical compositions or constructing instruments.
- Use digital tools and music software for composition and recording.
- Collaborate in teams to plan, create, and present original music or instruments.
- Develop skills in analysis, design thinking, and interdisciplinary problem-solving.

Attitudes

- Cultivate curiosity and appreciation for both science and music.
- Cultivate creativity and open-mindedness in connecting science with artistic expression.
- Build confidence in presenting and explaining personal work to diverse audiences.
- Encourage responsibility and initiative through collaborative tasks.
- Promote a positive attitude towards sustainability by using recycled or everyday materials in instrument construction.

1.3. Available partnership opportunities

Here are some partnership opportunities you should consider in your development:

Stakeholder	Partnership description/Contribution
Parents	Support the musical performances by offering expertise or attending events.
Local businesses	Provide financial or material contributions (e.g., instruments, venues).
Local authorities	Assist with promotion and community engagement.
NGOs	Offer workshops or resources linking music and science.

Artists	Guide students in composition and performance techniques.
Researchers	Verify scientific accuracy and provide insights on scientific concepts.
Research institutes	Host workshops and provide resources for hands-on scientific experimentation.

1.4. Recommended resources

Students will mainly use digital music composition software, basic musical instruments available at school, and recording equipment provided by schools or supported by local businesses. A wide range of online tools can support students' creative expression and scientific inquiry. These include:

- Online synthesizers: such as [MusicLab Shared Piano](#), [MZ-101](#), Mod Synth IO, Viktor NV-1, and Web Synths, which allow students to simulate instruments and manipulate sound digitally.
- Samplers and sound effect tools: like [Playtronica](#) and Sampulator, for experimenting with environmental or thematic soundscapes.
- Sequencers and drum machines: including MusicLab Song Maker, Drumbit, and BeepBox, for creating rhythmic loops and structured compositions.
- Digital Audio Workstations (DAWs): such as [AudioTool](#), BandLab, and Soundtrap, which allow multi-track mixing and advanced sound editing.
- Online audio mixers and editors: like Middle Ear Media ChannelStrip and BearAudio Tool, to process recorded sound and enhance audio output.
- Music notation and visuals tools: such as Noteflight and MusicLab Kandinsky, for students interested in writing or visualising music.

In addition to digital tools, students are encouraged to create musical instruments using everyday materials (e.g. rubber bands, cardboard tubes, metal cans), and to engage in hands-on experiments. Also, suggested materials for further experimentation during the FEEL phase, include tuning forks, mallets, bowls, plastic wrap, rubber bands, water, and dry rice. These can be used in activities such as: Experiment #1: How does sound move? – where vibrations are made visible by striking a tuning fork and placing it in water; Experiment #2: Sound Waves – There's a drum in my Ear? – where students simulate how the human eardrum responds to sound using plastic wrap and rice.

Minimal financial resources may be necessary for specialised equipment or software licenses, potentially funded by local authorities or businesses. Teachers typically facilitate the activity during school hours or through extra-curricular sessions. Online communication tools will support consultations with artists and researchers.

1.5. AGE OF STUDENTS INVOLVED

9 - 12, 12 - 15, 15 – 18

1.6. SUBJECTS DOMAIN

Science, Technology, Engineering, Arts, Mathematics

2. Implementing the Activity following the Design Thinking Approach

FEEL <i>What is the problem demanding action from the schools</i>	Phase I – Question Teachers initiate discussion by introducing a scientific topic from the curriculum (e.g., waves, ecosystems, the solar system). Students brainstorm questions about how this topic could be expressed through music. Teachers facilitate exercises in rhythm, melody, and sound experimentation to spark creative thinking, focusing initially on understanding how sound is produced and manipulated scientifically (frequency, pitch, amplitude). Teachers introduce science-content music as an engaging method for enhancing conceptual understanding, vocabulary development, and student engagement, referring to findings from studies such as Governor, Hall, and Jackson (2013). This provides students with alternative explanations and mnemonic devices to support their learning. Jensen (2005) summarises why educators should include music in the curriculum: its social nature, emotional impact, ability to carry a message, accessibility and relevance. They can also link science and music during interdisciplinary weeks. In Italy schools are linking the two during “Settimana della Scienza” where students are presenting a piece that shows music and science connection. Phase II – Evidence Students undertake individual and group research to gather scientific information relevant to their chosen musical themes. For instance, students investigating ecosystems may explore animal communication and environmental sounds, while those studying wave properties might examine wavelength, frequency, and resonance. Teachers guide the research process by recommending credible sources, such as educational websites, online simulations, scientific videos, and scholarly articles, assisting students in interpreting scientific data. Students also participate in preliminary activities to understand the science of sound through hands-on experiments with tuning forks, strings, or digital simulations, exploring how physical characteristics affect sound production. This foundational knowledge supports students in selecting appropriate sounds to illustrate scientific phenomena accurately. The research activity is directed towards two possible outcomes: either students compose an original music piece or develop their own musical instruments, culminating in a brief performance to demonstrate their scientific and musical understanding.
IMAGINE <i>How could the schools – students act up?</i> <i>What partnerships are required?</i>	Phase III – Analyse Students analyse and categorise their research findings, discussing connections between the scientific data and potential musical elements such as tempo, rhythm, harmony, melody, dynamics, and timbre. They create mind maps or visual diagrams to organise their ideas and sketch initial concepts for either a musical composition or a musical instrument. For those designing instruments, this phase includes exploring the structure and function of different families of instruments (e.g., string, wind, percussion), and selecting which type they will mimic using accessible materials. Students could build how traditional instruments, like mandolino or tamburello in Italy or Laouto or flute in Cyprus, analyze how they produce sound and link these to physical properties.

	Emphasis is placed on how the physical properties of the materials will influence sound, linking scientific understanding to instrument design or composition. Phase IV – Explain Student groups collaboratively refine their creative concepts. For music compositions, they specify how each musical element corresponds to a scientific idea. For instrument design, students explain the scientific principles involved in sound production (e.g., vibration, resonance, air pressure) and justify their material choices and structural designs. They prepare supporting notes or audio samples to accompany their work. Teachers and researchers provide formative feedback, supporting both the clarity of the scientific explanations and the coherence of artistic outputs. Students and Teachers can also collaborate with local music conservatories where they can receive mentoring on acoustics and performance with feedback that connects artistic structure to scientific explanations.
CREATE <i>Describe the activities</i>	Phase V – Connect Students compose and produce their music using a range of tools and materials. They may use digital platforms such as AudioTool, Online Sequencer, or MusicLab piano for electronic production, or experiment with traditional instruments found in the classroom. Alternatively, students designing their own instruments will build prototypes using recycled or everyday items, applying knowledge from previous phases about how materials and shape affect sound. Teams specialise in areas such as composition, instrument crafting, technical production, and event planning, collaborating to bring together all aspects of the performance in a coherent and scientifically informed way. For example, in Italy, students in Bologna created instruments from recycled items during the “RicicleMusica” initiative, supported by Hera Group, combining sustainability education with sound engineering. During this phase teachers and students can incorporate similar partnerships, where students document how their chosen materials (e.g., olive oil tins or pasta boxes) influence timbre and pitch.
SHARE <i>How do you plan to share the outcomes of your activities and build new partnerships?</i>	Phase VI – Communication Performances are held during open school days or city events for the local community, parents, peers, and invited experts. Students explain the scientific concepts behind their compositions, encouraging audience engagement. Performances may also be shared online, broadening impact. Phase VII – Reflection Students reflect on their learning experience, evaluating their understanding of scientific concepts, teamwork, and musical skills. Feedback from the audience and experts is gathered to inform future improvements and celebrate achievements.

References

Governor, D., Hall, J., & Jackson, D. (2013). Teaching and learning science through song: exploring the experiences of students and teachers. *International Journal of Science Education*, 35(18), 3117-3140.

Jensen, E. (2008). *Brain-based learning: The new paradigm of teaching*. Corwin Press.

4.3 Learning Science Through Theater

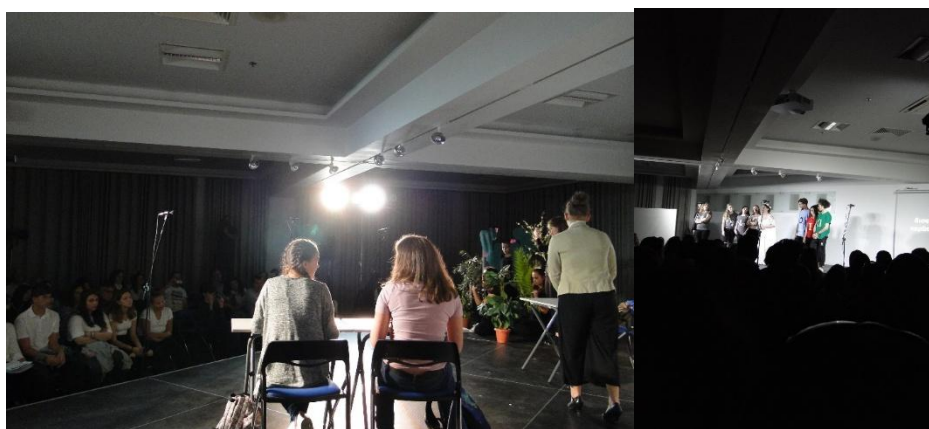
1. Description

1.1 Introduction



In the context of the activity, students **develop and implement a theatrical performance related to scientific concepts and learn science in a creative way**. The specific objectives of the activity, which have as a central axis the **interdisciplinary interconnection of science with aspects of art**, aiming at the enhancement of students' interest in science, involve both students and teachers.

More specifically, through this activity, students comprehend **scientific concepts** and phenomena, develop a spirit of **cooperation and teamwork**, actively participate in the elaboration of scientific concepts and they **develop creative and critical thinking skills**. Also, by participating in dissemination activities and entrepreneurial actions for the promotion and support of their theatrical performance, they contribute in further **bridging school with society** and at personal level developing their **social and entrepreneurial skills**.



Teachers will be engaged in **professional development** procedures through their cooperation and the exchange of opinions, ideas and teaching material (either in person or through online learning communities). Finally, one of the main aims of the activity is to motivate more and more teachers and students and create an **educational community** that will cooperate, exchange opinions, material and best practices for science teaching and learning, that will continue after the implementation of the action.

1.2 Learning Objectives

The main aim of the Learning Science Through Theatre (LSTT) activity is to give the opportunity to primary and high school students to stage a play and dramatize scientific concepts and knowledge from the material being taught in schools.

The LSTT's domain specific objectives are to:

- Get students interested in science and research through theatrical play
- Teach students how to develop a theatrical script, relevant to a scientific topic

- Initiate the development of a theatrical performance by students, regarding a scientific topic
- Initiate contact between students and other professionals (for example directors and musicians)
- Bring schools closer to local community
- Engage parents and the general public into schools' happenings and events
- Build National-wide student networks
- Open the school to the community and involve all the stakeholders.

Towards attaining these objectives, peripheral aims are formed addressing students' needs to:

- develop understanding about scientific inquiry
- develop abilities necessary to do scientific inquiry
- identify questions and concepts that guide scientific investigations
- design and conduct theatrical scripts relevant to scientific concepts and issues
- use technology to improve investigations, communications and the development of theatrical performances and videos
- formulate and revise scientific scripts exploiting creativity and imagination
- recognize, analyze and imagine alternative explanations and models
- communicate a scientific argument or issue in a creative way
- develop lifelong learning skills
- develop attitudes befitting a scientific ethos
- link with science and society in a personal context



The LSTT aims at the enhancement of the students' cognitive involvement, their representation of scientific content using their cognitive processes, the students' involvement using their bodies or gestures, their emotional involvement, the social interaction and communication between them, the use of past experiences and the creation of new ones based on sociopolitical and historical framework and on beliefs and behaviors, their brain, body and emotion coordination and finally the holistic use of their personality and their motives. As a result, students manage to constructively build on each other's ideas, enhance their learning of scientific concepts, co-create and perform theatrical plays.

1.3 Available partnership opportunities

Here are some partnership opportunities you should consider in your development:

Stakeholder	Partnership description/Contribution
Parents	Supporting, as externals, the students' performances in the various steps that will follow, either by offering their expertise if relative to the thematic/scenery demands or by personally attending the final events to cheer the effort.
Local businesses	Contribute by offering assets (either financial or in other material forms needed)
Local authorities	Supporting the whole process and disseminating the project to the local community for raising the awareness and contribute to the search for financial support
NGOs	Contribute by supporting with specific activities, e.g. Art NGO by providing artists, Science NGO by providing researcher.
Artists	Professional artists will have the chance to support the development and the staging of the play thus apprenticing the young students to the artistic aspects of the chosen thematic
Researches	Researchers are entrusted to spark the students' excitement in the chosen scientific concept. Furthermore, they will ensure the validity of the scientific elements of the performance and offer valuable help to the development of the script
Research institutes	Will offer a place for informal education that is complementary needed and targeted to the success of the performance. Will also engage students in the inquiry processes of researching.

1.4 Recommended resources

There are no financial resources needed actually. Students will develop all the needed costumes, scenery etc. If they need financial contribution, they could have the support of the local authorities and/or businesses as it was already support them in the last years (since 2014). For human resources, teachers usually realise this activity during their lessons or 2 extra hours per week for at least 8 weeks. This is usually within their project-based activities. Communication with professionals will be realized in person at schools, but also online. They will need an internet connect to connect with the organisers in specific time-frames for the support, PCs to prepare any possible presentation that they would like to involved in the performance.

1.5 AGE OF STUDENTS INVOLVED

9 - 12, 12 - 15, 15 – 18

1.6 SUBJECTS DOMAIN

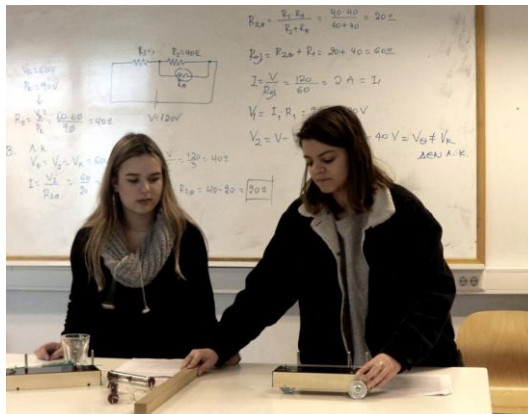
Mathematics, Science, Engineering, Arts, Technology

2. Implementing the Activity following the Design Thinking Approach

FEEL What is the problem demanding action from the schools	Phase I – Question Students pose, select, or are given a scientifically oriented question to investigate. Balance and navigation through dialogue aids teachers and students in creatively navigating educational tensions, including between open and structured approaches to IBSE The teacher chooses a chapter / module from the curriculum in which the students will be involved following the LSTT activity framework. Then, possibly on the occasion of a modern scientific subject related to this chapter, he begins a dialogue with the students, asking them questions. These questions will trigger a new round of questions from the students' side this time. At this point, the teacher should use these students' questions and come up with the subject that will eventually be explored and dramatized. Once the subject has been identified, the teacher can use and implement experiential warm up exercises both for the students to get acquainted with their body and with the rest members of the group as well as basic theatrical techniques. Some examples of exercises can be found below: 1) Students begin to move around under the instruction to continuously fill the gaps in space, without falling on each other. The moderator can stop the action and make corrections so that the space is always covered. As the group moves, the moderator gives the pace with the signal (1 → slow walking, 2 → faster ...) 2) The students gather in a circle and the moderator gives the instruction to choose a friend and an enemy but without letting them know. With his signal they start moving, trying to keep themselves constantly in between their enemy and their friend.  Phase II – Evidence At this stage, individual and teamwork plays an important role, aiming at finding and gathering the necessary information about the main inquiry question that has been asked. It is also important to strengthen and empower students to produce individual queries and discuss the evidence they found in the various sources they sought to look for.
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	The teacher in this phase ensures that all students have access to information on the exploratory question, whether via the internet (eg. YouTube videos, information from scientifically valid websites, etc.) or through printed material books (e.g. from the school library). The main concern is to coordinate the group of students in terms of searching and collecting the necessary information, as well as aiding the search for information within the chosen topic. The information search process can be facilitated by the teacher by providing basic search guidelines (eg. suggested links to students, suggested subqueries to explore, providing search keywords for search engines, etc.) Students search the web for information on the question / topic they chose to explore. They can work both individually and collectively, exchanging key findings and information they have collected. 
IMAGINE How could the schools – students act up? What partnerships are required?	Phase III – Analyze The main characteristic of this phase is the organization and analysis of the data collected during the previous phase of the exploratory process as well as the dialogue between the students to categorize the data. The teacher functions more as a facilitator of the process, and coordinates discussions among students about the data collected. Also, encourages the creation of organized information models, and search rules / standards pursuant under which the data will be organized. To achieve this, the teacher can provide students with a template according to which they will categorize their data. He then encourages and coordinates the group of students to improvise and create a first version of the theatrical performance. At this stage, students analyze and categorize the collected data while identifying different models of organizing information. Then they make a first attempt to capture the idea and create the scenario on which their

theatrical performance will be based. Essential role in this phase plays the **improvisation of students** as they attempt to set up a basic skeleton of their performance in a spontaneous way.



Phase IV – Explain

A key feature of this phase is the **dialogue between students** in order to extract and decide on the possible explanations and answers for the exploratory question that have been raised and which make sense to the pupils themselves.

The teacher acts as facilitator and process coordinator while identifying and correcting possible misconceptions of students about the interpretation of the data collected in the previous phase. Sample of scripts developed during this phase (in Greek):

I, electricity

Ένα θεατρικό δράμα από τους μαθητές της 82 τάξης
του Ζωννείου Πειραματικού Λυκείου Πειραιά.
Στα πλαίσια των θεματικών εργασιών στη Φυσική.

Βασισμένο στο μονόπρακτο του Ανδρέα Κασσέτη
"Αυτός κι αν ήταν έρωτας, Μανητήδα... Κεραινοβόλος!"
με την τεχνική του devised theatre

Πειραιάς 2018

At this stage, **students collaborate and talk about making decisions about the basic explanations they will adopt to answer the question** they have asked and then proceed with the creation of their theatrical performance.



CREATE

Describe the activities

Phase V – Connect

A key feature of this phase is **interdisciplinarity**, as students conquer scientific concepts and knowledge interconnecting scientific knowledge with various forms of art.

The teacher takes full advantage of the possibilities offered by the **interdisciplinary approach of teaching**, as it promotes the **interconnection of various scientific themes with various forms of art** (theater, music, painting). To achieve this, a communication and consultation with

	specialists in the field is pursued (specialist scientist in science education, specialized director, musician, etc.). In addition, the teacher coordinates the corresponding groups of students who have undertaken to create the script, music, costumes, etc.) Students in this phase explore the subject spherically and find interconnections with other fields, such as the arts (theater, music, painting, etc.). They are divided into groups according to their interests, in order to design and implement a complete theatrical performance with scientific content related to the exploratory question / theme originally set. Thus, pupils are divided into groups of directing, music production, scenography and costumes, choreography, video production, sound and lighting, promotional activities. They use all their imagination and creativity to achieve the best possible result and produce the final products in each category. Collaboration exists both in between students belonging to the same group and pupils belonging to different groups, so that the results produced are consistent. 
SHARE How do you plan to share the outcomes of your activities and build new partnerships.?	Phase VI – Communication The main feature of this phase is the dimension of pupils' communication, both with their classmates and with special scientists and specialized artists. In addition, communication also involves the expression of scientific concepts and findings by pupils through their theatrical performance. Sample video of a theater performance: https://www.youtube.com/watch?v=kmOCIPpMBuA At this stage the teacher encourages students to communicate with scientists and artists so that students can express and communicate the findings of their exploratory process in the best possible way to the public through their theatrical performance. The teacher has previously taken care to arrange a special scientist's visit to the science and / or artistic session (director, musician, etc.) at the school for students to address their questions. Finally, the teacher, in conjunction with the organizers of the action, takes care to ensure a specific day for a rehearsal of the group of students. Finally, the teacher is responsible for coordinating the final performance of the pupils. 

Students in this phase **communicate with artists (directors, musicians etc.) and the scientist who may even visit the school to be consulted.** They ask them questions about various ways of improving the theatrical performance. In addition, both during their rehearsals and during their final theatrical performance, students communicate through their bodies and through various gestures scientific concepts and issues that they have explored throughout the exploratory process.



Phase VII – Reflection

The main feature of this phase is student reflection and assessment of the exploratory process and learning.

The teacher at this stage of the exploratory process, which is the last one, discusses with the students' group what went well and what not when the students' theatrical performance was implemented. **The teacher evaluates whether all students have been involved in the creative exploratory process and completes an observation form** provided by the organizers of the action, which helps in describing and assessing by the teacher both the course of student exploratory learning and the successful - or unsuccessful - elaboration of scientific meanings by students, through embodied learning, always in the context of the curriculum of the classroom in which students are studying.

At this stage, **students** are evaluated **both by the judges (scientists and artists) of the final theatrical performance and by the audience of theatrical performance.** Then, after receiving their awards and distinctions, they discuss both with each other and with the teacher about the characteristics of the performance and the factors that contributed to the results of their final play.

4.4 Students as Change Makers

1. Description

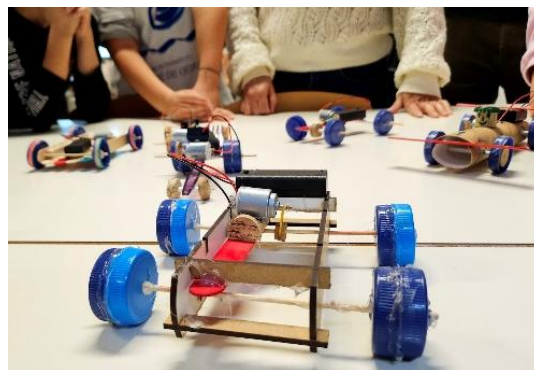
1.1 Introduction



The Maker movement has been revolutionizing the world of STEAM education by raising awareness for the power of learning by doing and of creativity to solve real-life problems. While maker spaces are often associated with the use of expensive and state-of-the-art technologies, like 3d printers, laser cutting and engraving machines, maker education focuses on **learning how to create innovative solutions by using what is at one's disposal**. This means that anyone can be a maker as long as they put into practice competences, such as **resilience, resourcefulness, creativity, innovation and**

collaboration. Students that engage with maker education develop important competences for life, while deeply learning curriculum content associated with real-life situations. Furthermore, they understand that they can be active citizens and contribute to the improvement of their communities if only they find the opportunity and inspiration for it.

Change Makers activities encourage teachers and students to learn basic and advanced creative digital skills and apply them in real-world contexts. More importantly, it encourages them to become change agents in their communities, designing innovative solutions to local problems, using whatever resources that are available.



Professional development opportunities will be offered to teachers to build capacity in maker education and prepare them with important STEAM digital skills (such as 3d modelling and printing, vector design, electronics, programming, among others). Training courses will privilege pedagogical models that follow a student-centered approach, such as Design Thinking and assessment strategies to assess students' competence development in an equitable approach. Workshops

Workshops for students will be organized to promote the same STEAM digital skills and other important competence such as collaboration, resilience, creativity, resourcefulness, etc, in students and encourage students to develop creative solutions for existing local problems.



1.2 Learning Objectives

The main goal of Change Makers activities in STEAM Innovation will be to support students through an entrepreneurial journey to develop an innovative solution to an existing local problem. To support this, will be to develop maker competences while learning curriculum content (when integrated in formal education) or exploring other learning outcomes related to real-life contexts (when integrated in non-formal education). While the main goal is the development of competences, the learning content will vary according to the project theme students and teachers select.

In this sense, in addition to deeply learning content related to their projects' theme, students who engage with Change Makers activities will develop competences related to:

- Digital fabrication: 3d modelling and printing / laser cutting and engraving
- Vector design and digital creativity
- Electronics and electric circuits
- Programming and sensor
- Artificial Intelligence

While learning these specific digital skills, students also develop:

- Creativity: students must use creativity to invent new solutions for local problems
- Resilience: students must develop the ability to continue trying despite difficulties and failures
- Resourcefulness: students will have to design solutions using whatever resources they have at their disposal.
- Innovation: Students will have to be innovative to be able to solve problems that have not been solved before.
- Collaboration: Students will work in groups, therefore they will develop collaborative abilities.
- Communication: To properly work in groups, students will have to learn how to listen and speak with respect and in a clear and effective manner.
- Active citizenship: Students will understand that whatever their age, they can be active citizens and promote improvement in their community.

In the context of STEAM Innovation, students will be invited to not only develop a creative solution for an existing local problem but to become agile communicators and "sell" their ideas to others. Through this, they will also develop **self-confidence** and **entrepreneurial competences**.



1.3 Available partnership opportunities

Here are some partnership opportunities you should consider in your development:

Stakeholder	Partnership description/Contribution
Parents	Verify if students' parents present any skills that can complement the work they are doing. Maybe some work in STEAM professions. Others might be handicraft enthusiasts or 3d printing lovers. Even if none of these are applicable, diversity of perspectives is always enriching, and parents can help with new ideas and contribute in whatever way they want.
Local businesses	Schools should search for nearby maker spaces and FabLabs that might be willing to collaborate. Local businesses can benefit from students' creations. Students can perform an initial participatory study with the local business community to see whether they have any issues that need to be solved. They can also contribute to students' work with resources, funding, skills and ideas.

Local authorities	Local authorities can support students' work by offering insights into local issues and existing solutions. Students should also share their solutions with local authorities and share recommendations for community development.
NGOs	Local NGO's can also support students' work in defining local issues that need to be solved and cocreating solutions. They can also
Artists	Inviting artists to cocreate the solutions for the identified issues can be a form to enhance the artistic quality and foster artistic competences in students. If a local resident artist exists, they can be invited to be part of the students' work. They can also be engaged as consultants.
Researchers and research institutes	Research institutes might already be working on creating solutions for existing local problems. They can be invited to offer insights to students and to spark their interest in the science behind the issues selected. They might also have resources and mentors available for students.
Local community	Search the local community for daycare centres, youth associations and other community stakeholders that might want to be part of students' projects, either as contributors with ideas or as cocreators of the solutions.

1.4 Recommended resources

Students can work with any resources they have at their disposal. If the school has 3d printers and/or laser cutting and engraving machines, they should be made available for the students. Likewise, electronics and programming kits, if existing, should be offered for usage during the project.

However, students can design innovative ideas and solutions for existing problems using reusable materials such as cardboard, inks, glue, tape, scissors, and whatever handicraft material they can access.

1.5 AGE OF STUDENTS INVOLVED

9 – 18

1.6 SUBJECTS DOMAIN

All

2. Implementing the Activity following the Design Thinking Approach

FEEL <i>What is the problem demanding action from the schools</i>	Phase I – Question This is the moment when the project begins. In this phase students will choose or be introduced to the theme that will be explored throughout the project. The goal is for them to engage in deep and comprehensive learning about the topic, how it relates to their daily lives and what elements of their community it affects. Teachers should think of a way to motivate and engage students when introducing the theme, to captivate them from the start and keep them involved throughout the project.
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	This is also the phase in which students should pose their own questions, create hypotheses (supported by valid arguments), and find opportunities to research and experiment in order to reach their own conclusions about the problem at hand. The aim is for students to fully understand the problem so that in the next phase, they can unleash their imagination and think of possible solutions. On the “feel” phase it is important that teachers inspire students to think about real-life challenges that need attention in their school or local community. Students must explore and ask powerful questions to discover local necessities and maybe systemic issues. Students might explore: • What problems affect our school or neighbourhood most? • Are there everyday challenges that people have just "gotten used to"? • Who is impacted most by these problems? How? • What would be our ideal community or how could our school look like? • How can we make our school more sustainable or inclusive? The identification of real-live challenges within their schools or local community can encourage students to build empathy. They can look beyond their immediate experience and consider the perspectives of others in their community. Furthermore, this phase can present an important opportunity to raise the voice of students and allow them to be involved in the schools’ daily lives in a democratic way. Phase II – Evidence Once questions are formed, students can begin to gather data and evidence to better understand the problem. For that students can do (1) Interviews with peers, teachers, family members, and local stakeholders; (2) Surveys or polls to gather broader input; (3) Observation (e.g., spending time noticing behaviours, workflows, pain points); (4) Research into existing data, policies, or scientific studies. (5) Register important dates. Teachers can teach students on how to record and interpret their findings critically, identifying patterns, contradictions, or unexpected insights. This stage lays the foundation for truly needs-based innovation and encourages students to think like community researchers. To a fluid work, students can use field notebooks, Audio/video recordings of interviews, empathy maps and stakeholder maps, Google Forms for digital surveys, community walk-throughs (with a checklist of observations). This phase helps shift students from “we think the problem is...” to “we know the problem is...because we’ve seen and heard the evidence.”
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IMAGINE <i>How could the schools – students act up?</i> <i>What partnerships are required?</i>	Phase III – Analyze At this point, students should already be “experts” in the topic they are working on. They already understand the problem and how it relates to their daily lives and the different elements of their community. This phase is the phase of letting their imagination run wild and exploring all the ideas that may arise between students and teachers about what to do to solve the problem. It is also the moment to think about what the goals are: To bring awareness to a topic? To solve a practical problem? To create something new? Once the goals are well established, an open “brainstorming” session should be organized where students think about how to achieve the goal. With the objective to narrow down the problem, students can work collaboratively into a clear and actionable challenge statement. For example: “How might we help students who feel excluded during recess to feel more included and engaged?” This is the starting point for idea generation. In this phase, students can use Problem Trees / Root Cause Diagrams and/or SWOT Analysis (Strengths, Weaknesses, Opportunities and Threats). They can brainstorm around “How Might We...” questions and do a Stakeholder Mapping Suggestion: Do an imagination icebreaker to kick-start students’ ideas: Students can write down as many ideas as they can in a short period of time. Ex: 5 minutes. Then the ideas can be organized into categories (e.g. easy/hard ideas, short/long term ideas, fun ideas, out-of-the-box ideas, etc.). In a third phase, students should choose one or more concrete ideas on which they will work in the next phase. If there are community stakeholders involved in the project, they should be invited to participate in the brainstorming session. Sometimes the best ideas come from the most unexpected places. Students might identify the root causes of the problem. They can Map out needs and constraints (e.g., time, resources, knowledge), identify patterns and leverage points where action would be most effective and discuss how STEAM knowledge and makers way of thinking might address the issue. Phase IV – Explain Students will begin to generate creative ideas after the definition of the challenges. They might identify who they need as partners to turn those ideas into reality and it is important to always remember who will be the target audience for the product you will create in the project. Students must think of ideas that suit this audience so that the project has the real intended impact. The needs of this audience should be considered
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	and how they can be addressed with the project. If the final target is not an audience, but some other element of the community (plants, animals, a lake, a street, etc.), the process remains the same. Always consider as the main factor, the real needs you are addressing. The students can brainstorm multiple possible solutions, even unconventional or wild ideas. They can also explore what skills or resources they might need to implement them. In this phase they can draft a preliminary project plan or prototype concept and identify potential partners (parents, NGOs, Makerspaces, artists, businesses, etc.) The goal is to articulate a vision for change — not just what the solution might be, but how it could work in real life, with real partners, in real communities. Here is an example output: “We imagine developing a low-cost air quality monitoring station using Arduino sensors, which can be installed around our school and neighbourhood. This station will display real-time pollution data on a digital screen. We will partner with a local Makerspace to 3D-print the casing, collaborate with a science teacher to calibrate the sensors, and invite a local NGO focused on environmental education to help us raise awareness through school campaigns.
CREATE <i>Describe the activities</i>	Phase V – Connect Students will create something to carry out the ideas they selected in the previous phase. They will be able to create anything, so that in the final phase of the project they can share it. It is important to think concretely about what they will create, how much time it will take, what materials they will need, what support they will need, etc. Give students the opportunity to do some organized planning of the process before they begin. Anticipate what they will need to be successful and what steps they will take. If possible, allow the error to happen. It is through mistakes that students find the opportunity to correct themselves and learn more deeply. It is natural that at this stage they will encounter several moments of trial and error until they manage to create the planned product. It is also possible that when putting ideas into practice, students recognize that some ideas may need to be revised, so it is important to keep a record of all the ideas that emerged in the previous phase. Students can design and build their solutions using Maker methodologies. They can organize into collaborative teams and begin to work on their prototypes, using available tools and materials.

	The activities involve: • Plan the project workflow (materials, tools, timelines, roles) • Use Maker technologies (when available) like: ○ 3D modelling and printing to design enclosures or custom parts ○ Vector design software for signage, interfaces, or decorative elements ○ Laser cutting to create precise components from wood or acrylic ○ Arduino or micro:bit platforms to develop smart, interactive features ○ Electronics kits to integrate sensors, lights, or motors • Combine digital fabrication with recycled or low-cost materials (e.g., cardboard, plastics, scrap wood, etc) Here is an example output: “Students can build a smart plant watering system using Arduino/Micro:bit moisture sensors, 3D-printed parts, and a laser-cut display panel showing soil humidity. They connect with the school janitor and local gardening club to test it in real garden beds.” This phase focuses on experiential learning, where failure and iteration are part of the process. Students learn to adapt, debug, and optimize their prototypes while applying real-world STEAM concepts. An outcome can be a functional prototype that addresses the challenge identified, created using Maker tools and collaborative problem-solving. In cases where students don’t have all the necessary materials available they can design a mock-up representing their idea, using recycled materials and use storytelling to explain the idea behind it.
SHARE <i>How do you plan to share the outcomes of your activities and build new partnerships?</i>	Phase VI – Communication This is the final phase of the project, and the most rewarding moment of all. It is time to share the work!! At this point, the product will already be created and the only thing left to do is plan how it will be shared. This stage will vary depending on the project objectives, however the common aspect is the planning and dissemination that must be done beforehand. At this point, students should prepare to share their results with the class/school/families/community, etc., in order to achieve the greatest possible impact. They can showcase their Maker-based solutions in various formats and platforms. This method can amplify their voice and build visibility for their work. The goal is to communicate the impact of their projects and engage stakeholders who can support further development. Activities include: • Organizing a local exhibition or “Maker Fair” at school or community center and invite parents, local businesses, authorities, and NGOs.

	• Showing the prototypes in public events (e.g., municipal sustainability week, tech expos). • Creating videos or portfolios where they can explain the challenges, design process, and final product. • Sharing the outcomes on social media, school websites and newsletters to reach a broader audience. • Engaging partners by inviting them to evaluate or contribute to future iterations of the solution. When sharing, students should remember to record the moment with photos and videos as a keepsake. Example: Students designed an automated bird feeder using 3D-printed parts and programmed a sensor-triggered food dispenser. They created a project video tutorial and published it on the school's YouTube channel and website. They also hosted a “Tech for Nature” open day where local environmental NGOs and parents were invited to test the prototype and discuss possible improvements for local biodiversity support. Phase VII – Reflection Reflection helps consolidate the learning experience and evaluate both the process and the impact of the activity. This stage reinforces metacognitive skills and identifies future opportunities. Activities can include: • Guided group discussions on: ○ What went well? ○ What was challenging? ○ What would we do differently next time? • Creating a reflection journal or video diary to document individual and team learning. • Feedback sessions with teachers, peers, and community partners. • Mapping out next steps (e.g., how to continue improving the prototype or scale the solution). Example: Students reflect on how learning to solder and code helped them bring their air quality station to life, and how working with local environmental groups gave them real-world purpose. Students discuss on the success of their project and how they can improve the discovered limitations. It is also important to celebrate the success and ensure students feel proud in the end.
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5 Conclusions

The STEAM Innovation project is expected to effectively address the diverse educational needs of Greece, Cyprus, Italy, and Portugal by adopting a design thinking approach integrated with the Inquiry-Based Learning (IBL) model. This dual framework will place users—students, teachers, and communities—at the center of the process, enabling a dynamic cycle of empathy, problem definition, ideation, prototyping, and testing. At the same time, the inquiry-driven model will empower learners to explore, question, and co-construct knowledge through hands-on, real-world challenges.

Across all participating countries, this methodology will directly respond to the common barriers identified in local forums and expert groups: fragmented curricula, limited interdisciplinary teaching, outdated assessment models, and uneven access to resources. The design thinking process will allow educators and learners to reimagine classroom practice in a collaborative, iterative way, while IBL will ensure that learning remains student-centered and rooted in exploration and curiosity.

In Greece and Cyprus, where teacher professional development and curriculum reform are pressing concerns, the approach will promote teacher confidence and foster innovation within traditional systems. In Italy, where cultural institutions and creative industries are strong, the model will encourage deeper interdisciplinary partnerships, aligning well with national priorities for innovation. In Portugal, where integration of families and local communities is emphasized, the model's collaborative nature will support inclusive and locally relevant STEAM solutions.

Overall, the STEAM Innovation methodology is expected to generate both systemic insight and practical change, offering a flexible, scalable framework that will align with the educational transformation goals of all four countries.

The STEAM Innovation educational and methodological blueprint gives the main structure as well as the guides on how to proceed with the Educational program development (D2.3) where the partnership will develop an educational syllabus, lesson plans, educational materials, and assessment tools based on the presented structure in section 4 of the present document. The program will be designed to be modular, allowing educators the flexibility to adapt it to their specific contexts and resources while maintaining the integrity of the STEAM approach.