SENSE. The New European Roadmap to STEAM Education

Policy brief RP1

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Project coordinator:	Lydia Schulze Heuling, Western Norway University of Applied Sciences
Contact:	HVL-SENSE@hvl.no
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Author List

Institution	First name and Name	Contact information
HVL	Lydia Schulze Heuling	lshe@hvl.no

Abbreviations and acronyms

Abbreviation or acronym used in this document	Explanation
EU	European Union
R&I	Research and Innovation
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEM	Science, Technology, Engineering and Mathematics
VET	Vocational Education and Training

Glossary

Term	Definition used or meaning in the SENSE. project	Reference or source for the definition if applicable
Embodiment	Forms of knowledge which are acquired through somatic experience and interaction with the environment.	D3.4, D3.5
STEAM beneficiary	STEAM beneficiaries are individuals or organisations who directly gain advantages from a STEAM-focused initiative as SENSE. They experience direct improvements in learning, skill development or well-being. For instance, students participating in a STEAM education program are beneficiaries as they directly benefit from the enhanced learning experiences and opportunities for creativity and critical thinking.	D3.3
STEAM Stakeholder	STEAM stakeholders encompass a broader range of entities such as students, companies or policy makers. Each of these groups has distinct interests and roles in the success of a STEAM initiative. For example, educators contribute to the design and delivery of STEAM curricula, while policymakers influence funding and educational	D3.3

| | policies related to STEAM education. | |

The SENSE. project

There is a widespread understanding that the future of a prosperous and sustainable Europe depends to a large extent on the quality of science education of its citizens. A science-literate society and a skilled workforce are essential for successfully tackling global environmental challenges, making informed use of digital technologies, counteracting disinformation, and critically debunking fake news campaigns. A future-proof Europe needs more young people to take up careers in science related sectors.

Research shows that interest in STEM subjects declines with increasing age. This effect is particularly pronounced among girls and young women; even those of them who take up science studies gradually forfeit their motivation. But despite all image campaigns and efforts to remove the awe of science only "one in five young people graduates from STEM in tertiary education" and only half as many women as men, according to the European Skills Agenda.

The disinterest in science is striking and evokes the question of its causes. Stereotypes and lack of female role models seem to be only a part of the explanation. Nor is there a lack of career prospects that could explain a reorientation despite initial interest.

SENSE. has identified two major problems in current science education that need to be addressed: a) A distorted teaching logic that progresses from abstract models to procedural applications ("reverse ontology") and b) The inability to implement a learner-centered pedagogy linking students' everyday knowledge to science-based knowledge, thus promoting motivation, self-directed and life-long learning.

SENSE. advocates for the development of a high-quality future-making education that is equally accessible to all learners and promotes socially conscious and scientifically literate citizens and professionals. SENSE. aims at radically reshaping science education for a future-making society. By promoting the integration of all human senses into exploring and making sense of the world around us, we will challenge conventional ideas of science and science education. Considering the pitfalls of current science education practices and the advantages of artistic and aesthetic activity, this innovative approach also considers social inclusion and spatial design as core components for a new STEAM education paradigm. With 'SENSE.STEAM' future science learning will be moving away from the standardised classroom shapes and furniture layout entering new learning landscapes.

The project seeks to develop an accessible educational roadmap promoting socially conscious and scientifically literate citizens and professionals. It addresses outdated perceptions of current science education as well as gender stereotypes by integrating the arts, social inclusion, and spatial design as its core components. SENSE. will establish 13 'STEAM Labs' across Europe to develop and evaluate the

'SENSE. approach' to STEAM subjects alongside students, educators, teachers, businesses, and other stakeholders.

The 'New European Roadmap to STEAM Education' will take the shape of a STEAM learning companion to support tomorrow's educators and learners – be it in the classroom, in a museum or on a drilling rig. A digital hub will be established, where practitioners from all ages and backgrounds across Europe will be able to access tried and tested educational practices to increase engagement within these subjects.

The SENSE. consortium

Høgskulen på Vestlandet	Inndalsveien 28 P.O Box 7030 5020 Bergen, Norway	https://www.hvl.no/en/
odyssea	Karditsis 8A Athina 104 40, Greece	www.odyssea.org.gr
Pädagogische Hochschule Weingarten	Kirchplatz 2, 88250 Weingarten, Germany	www.ph-weingarten.de
CREDA ONLUS	Via Mulini Asciutti 2, Parco Monza 20900, Monza, Italy	www.creda.it
wecf	Kote Elisabethstraat 6, Utrecht 3511 JG, Netherlands	www.wecf.eu
geyc	Strada SF Elefterie 31 Corp a et 2 AP 3, Bucuresti 050524, Romania	http://www.geyc.ro

LOUVRE	Quai Francois Mitterand 34/36, Paris 75001, France,	www.louvre.fr
Hawkins\Brown	22 Elyplace, Dublin D02 AH73, Ireland	www.hawkinsbrown.com
VELVET	Telliskivi 60a/5, Tallinn 10412, Estonia	www.velvet.ee
UNIVERSITAT DE BARCELONA	Gran Via De Lescorts Catalanes 585, Barcelona 08007, Spain	www.ub.edu
EFEE THE EUROPEAN FEDERATION OF EDUCATION EMPLOYERS	Rue Des Deux Eglises 26, Bruxelles 1000, Belgium	www.educationemployers.eu

The SENSE. Associated Partners

VILVITE	Thormøhlensgate 51 5006 Bergen, Norway	www.vilvite.no
TRELLEBORG	Johan Kocksgatan 10 P.O. Box 153 231 22 Skåne län, Trelleborg, Sweden	www.trelleborg.com
FUNDACIÓ BOFILL Educació per canviar-ho tot	Provenca 324 08037, Barcelona, Spain	www.fbofill.cat

	Irisvej 36 Anette Schulz P.O. Box 000 7100, Velje, Denmark	http://www.schools-for-health.eu/she-network
Primăria Municipiului Câmpina	Bulevardul Culturii Nr 18 105600 Sud – Muntenia, Campina, Romania	www.primariacampina.ro
THE UNIVERSITY of EDINBURGH	Old College, South Bridge EH8 9YL, Edinburgh, United Kingdom	www.ed.ac.uk

Executive Summary

This policy brief serves as a comprehensive guide providing evidence-based insights and recommendations for policymakers, stakeholders, and educators. It aims to promote the integration of Science, Technology, Engineering, Arts and Mathematics (STEAM) approaches into education policies and practices, and to foster innovation and collaboration across the learning ecosystem.

The intended readership of the briefing encompasses a wide range of stakeholders who are key to advancing European STEAM education. It is aimed at students aged 13-18 to help them make informed decisions about their academic and career paths. Young adults aged 19-25 are offered insights to guide further study and career choices, while the brief specifically targets girls to challenge gender stereotypes and widen access to science-related studies and careers.

Parents have an important role to play in supporting their children's educational journey and choices. Private and public sector employers and businesses are highlighted as key audiences, emphasising the importance of a workforce prepared for the digital and green transitions. Educators, including teachers, schools and science museums, will be equipped with pedagogical tools to seamlessly integrate STEAM into curricula.

Recognising the potential of cultural and artistic institutions as informal learning spaces, the brief highlights their role in fostering the convergence of science and the arts. Academics in higher education and research are encouraged to integrate STEAM inquiry and research methodologies into their programmes. Policy and decision-makers are a key audience, driving the integration of STEAM across the learning continuum.

Finally, the general public is engaged as the brief seeks to cultivate a scientifically literate citizenry and foster a society that addresses challenges through lifelong learning practices.

The structure of the document is as follows: It outlines the key findings and recommendations presented in the first SENSE. policy brief, exploring the transformative power of STEAM education. Its scope and intended readership are detailed, followed by an overview of its structure.

Section 2 introduces the focus of the document, setting the stage for an in-depth exploration of the transformative potential of SENSE.STEAM education.

Section 3 presents policy recommendations in four areas. Topic 1 addresses skills shortages and promoting STEM careers, while Topic 2 emphasises gender equality and social inclusion through STEAM. Topic 3 explores the use of STEAM in forward-looking policy areas, such as the Green Deal, health, and digitalisation. Topic 4

highlights the role of STEAM in driving educational innovation across the learning continuum, developing adaptable and forward-thinking individuals.

This policy brief provides actionable insights and recommendations to help advance European STEAM education across a wide range of stakeholders and spheres of influence.

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1. Introduction

In an era of rapid technological progress and dynamic societal change, the importance of science, technology, engineering, arts and mathematics (STEAM) education has never been greater. This policy brief provides a comprehensive overview of the transformative potential of STEAM education and its central role in shaping Europe's educational landscape. Covering a range of dimensions, from skills shortages and gender equality to policy alignment and educational innovation, the following sections set out a vision for improving STEAM education across the continent. By examining the policy background, SENSE.STEAM methodology, project activities and key findings, this brief provides readers with a holistic understanding of the landscape. The subsequent section on policy recommendations offers actionable insights to move Europe's STEAM education forward and ensure a generation prepared to succeed in a dynamic world.

1.1. Purpose of the document

The purpose of this document is to succinctly and persuasively communicate evidence-based recommendations and insights to policymakers, stakeholders, and educators. It aims to inform decision-making, drive the integration of Science, Technology, Engineering, Arts, and Mathematics (STEAM) approaches in educational policies and practices, and foster innovation and collaboration in the learning ecosystem, building upon the work already undertaken during the first year of the project SENSE., and Deliverable 3.1(STEAM DNA Workshop), Deliverable 3.2 (Report on the Citizen Science and Art Practices Workshop), Deliverable 3.3 (Stakeholders challenges and needs), Deliverable 3.4 (Knowledge and practices) and Deliverable 3.5 (SENSE.STEAM Methodology).

1.2. Intended readership

The intended readership of this policy brief encompasses a wide range of stakeholders who are essential for the advancement of European STEAM education. It is aimed at students aged 13 to 18, helping them to make informed decisions about their academic and professional futures. It is also aimed at young adults aged 19-25, providing insights to help them make further study and career choices. The brief also addresses gender stereotypes by targeting girls, with the aim of widening their access to science-related studies and careers.

Parents are also an important target group, as they play an active role in supporting their children's educational pathways and decision-making processes. For private and public sector employers and businesses, the policy brief highlights the importance of developing a workforce that can meet the demands of the digital and green transitions. Educators, including teachers, schools and science museums, are

essential readers, who need to be equipped with the pedagogical tools needed to seamlessly integrate STEAM into curricula.

Cultural and artistic institutions are recognised for their potential as informal learning spaces that foster the intersection of science and the arts. It also addresses academic staff in higher education and research, promoting the integration of STEAM inquiry and research methodologies in PhD programmes and Horizon Europe projects. Policy and decision makers are key audiences as they drive educational policies and curricula that embed STEAM across the learning continuum. Finally, the general public is a key audience, as the policy brief aims to cultivate a scientifically literate citizenry, fostering a society that addresses societal challenges through informed and lifelong learning practices.

1.3. Structure of the document

This document outlines the key findings and recommendations presented in the first SENSE. policy brief. The brief addresses a number of compelling themes that underscore the transformative potential of STEAM education. The following sections explore the scope of this policy brief and its four distinct themes:

Section 2 provides an overview of the focus of the document, setting the stage for a comprehensive exploration of the transformative power of SENSE.STEAM education.

In section 3 we present policy recommendations in four areas. Topic 1 addresses that STEAM addresses skills shortages and promotes STEM careers: In this section, we explore how STEAM education is addressing the skills shortage while boosting opportunities and careers in STEM. Topic 2 focuses on promotion of gender equality and social inclusion through STEAM. We highlight the role of STEAM in breaking down gender barriers and promoting inclusivity in science, technology, engineering, arts and mathematics. Topic 3 is about leveraging STEAM for forward-looking policy areas. Here we explore how STEAM education aligns with future-focused policy areas such as the Green Deal, health and digitisation, increasing its impact on shaping tomorrow's society. Lastly, in Topic 4 we propose that STEAM drives educational innovation across the learning continuum, how STEAM education drives innovation at different stages of education, providing a continuum of learning experiences that foster adaptable, forward-thinking individuals.

The following pages delve deeper into each topic, providing in-depth insights and actionable recommendations that together contribute to advancing European STEAM education.

2. Scope of the first SENSE. policy brief

This section lays down the scope of this first policy brief, providing the overall policy background and context, giving an overview of the project, its ambition and findings so far and how these led to the elaboration of our first policy recommendations.

2.1. Policy background and context

The future of a prosperous and sustainable European Union (EU) strongly depends on the quality of scientific education of its citizens. To effectively tackle global environmental challenges, harness digital technologies and counter disinformation campaigns, the promotion of a scientifically literate society and a skilled workforce is paramount. Surprisingly, only 28% of secondary school students choose scientific careers, contributing to the stagnation of the EU's research and innovation (R&I) performance over the last decade. This gap in science-oriented professionals, combined with a retiring age group of 45–65 year olds, calls for an urgent response.

Over the past 15 years, the EU has invested heavily in STEM and STEAM education projects, but with limited success. The career paths of girls and young women remain unchanged. The decline in interest in STEM during the teenage years underlines the need for a pedagogical shift. To strengthen Europe's R&I capacity and societal resilience, we need to nurture the potential of all students for the talent pipeline.

The resounding calls for "more scientists and a scientifically literate society" spurs us to action. We need to inspire enthusiasm for STEM across generations, break down gender bias and take advantage of the Green Deal, Health and Digitalisation policies. Bridging the gap between academia and industry means producing work-ready students and graduates. There is an urgent need to increase the attractiveness of science careers, showcase engaging content, and harness STEAM education.

Against this backdrop, our policy brief charts a transformative path forward that aligns education, policy, industry, and societal needs. By harnessing the potential of STEAM, including the vibrancy of the arts, we embark on a journey that will propel Europe towards innovation, resilience, and a brighter horizon.

2023 being the "European Year of Skills", our first two policy recommendations will directly respond to this priority in the European policy agenda.

2.2. Why a new European STEAM Roadmap?

The project 'SENSE. The New European Roadmap to STEAM Education' brings progressive transformation, transdisciplinarity and multi-perspectivity to traditional approaches to STEM education. By harnessing the dynamic potential of STEAM disciplines, the project aims to transcend conventional paradigms and cultivate new dimensions of education to transform the European landscape of learning, innovation and sustainability, addressing a wide range of stakeholders and their needs.

The SENSE. Roadmap offers a three-pronged approach, encompassing awareness, action, and advocacy, with the overall aim of providing learners and students across the learning continuum with new perspectives for a future that shapes Europe. Core values such as gender equality and social inclusion are fully embedded and embodied in the Roadmap.

The STEAM education journey begins with awareness. Through targeted initiatives, SENSE. aims to shed light on its objectives and invite educators, policy-makers and citizens to become curious and inquisitive.

From awareness to action, the roadmap will facilitate a seamless progression. With easy-to-use interfaces and adaptable tools, SENSE. empowers educators to integrate innovative STEAM approaches into their curricula. It will turn theory into practice, fostering a generation of learners equipped to navigate the complex landscapes of the future.

The SENSE. project is committed to advocacy as the culmination of its journey. Supported by tangible success stories and empirical evidence, stakeholders will be encouraged to champion the cause of STEAM education. The project will create a movement that will reverberate far beyond its inception, as educators, learners and policymakers become united advocates for a dynamic and inclusive educational landscape.

2.3. What is the SENSE.STEAM methodology?

Building on the extensive background experience and research conducted by lead members of the project consortium, the SENSE.STEAM methodology is grounded on the SENSE.STEAM model composed of four building blocks:

1) Learner Centred pedagogy: a radical shift from viewing learners as knowledge receivers to active creators of their own knowledge, promoting self-directed learning and empathy with others.
2) Reflective Feedback: "Feedback" drives development and transformation by prompting individuals to assess their emotions, thoughts, actions, and impact, fostering ongoing processes. Reflective feedback covers introspection and

interaction, enhancing personal encounters, empathy and engagement. This connection expands to humans and non-humans (such as feedback provided through interaction with an object), nurturing a holistic perspective of being in the world.

3) STEAM inquiry: In STEAM inquiry various elements of knowing and sense making converge: embodying experiences, probing questions, recognizing patterns, forging connections, showcasing empathy, embracing uncertainty, shaping significance, taking action, introspective reflection, and critical assessment. This framework finds application not only within the arts but also in the realm of STEAM research.

4) Citizen Science and Art practices: enabling school students to liaise directly with the public, as both science makers and science users. An Art-based Citizen science approach will facilitate engagement with both, scientists and artists, artistic interventions, theatres and science labs to explore, discuss and reflect together on matters that are important to the community.

The SENSE.STEAM methodology and its theoretical foundations are further elaborated in Deliverable D3.5, with presentation and discussion of its key components and core embedded pathways. We understand this methodology model as a living construct, open to change and that shall be transformed by the co-creation of stakeholders and supported by the knowledge, practice and lived pedagogy, as presented in Deliverable D3.4.

Furthermore, the project seeks to explore the potential replication of SENSE.STEAM across different countries, institutions, cities and schools with different levels of STEAM maturity and scale. This exploration is expected to inform the subsequent development of the Roadmap, the main final result of our project.

2.4. Who are the STEAM beneficiaries?

In order to ensure accessibility and long-term uptake, it is important to provide an overview of the stakeholders of the SENSE. project and of their needs and challenges in the context of future-oriented STEAM education. We have identified the following STEAM beneficiaries as target groups of our SENSE. Roadmap:

- Students aged from 13 to 18 years old, who need to make decisions on their future studies.
- Students 19-25, who need to decide about further study and/or choose a professional career.
- Girls who are afflicted by gender stereotypes limiting their access to science-related studies and professions.
- Parents, who are involved in supporting the education and decision-making processes of their children at various stages of the educational life-course.

- Private and public sector employers and businesses: who need to have work ready and creative students matching new job profiles related to digital and green transitions.
- Schools, teachers, educators, in formal and informal settings as well as science museums who need to be equipped with hands-on pedagogical tools to implement STEAM in curricula.
- Cultural and artistic institutions as spaces for the learning of science in relation to society. We want to bring to the fore and make explicit their role as legitimate and powerful informal learning spaces where science and the arts can productively meet.
- Academic staff in higher education and research, to promote and integrate STEAM inquiry and research methodologies in PhD programmes and research projects including Horizon Europe.
- Policy makers and decision makers who derive education policies and curricula embedding STEAM throughout the learning continuum.
- The general public: the development of a scientific literate citizenry is a fundamental goal of SENSE. that believes that social challenges are best dealt with by informed and scientifically literate citizens who have made lifelong learning their way of life.

An extensive report about SENSE.'s stakeholder needs and challenges analysis can be found in our deliverable D3.3.

2.5. Summary of project activities and findings so far

The progress of the SENSE.STEAM project has been both promising and impactful, as evidenced by the range of activities undertaken to date. In the early stages, two workshops served as drivers of innovation: the "STEAM DNA Workshop" held in Bergen, Norway, in November 2022 (see Deliverable D3.1 for more details) and the Citizen Science and Art Practices Workshop held in Paris, France, in March 2023 (see Deliverable D3.2 for more details). The outcomes of these workshops were echoed through a Delphi study, integrating feedback of 16 external experts into the development of our SENSE.STEAM methodology. The groundwork for the project's local "STEAM labs" has been carefully laid. These labs, soon to be hubs of transformation, ready to incubate ideas, foster experimentation and cultivate the essence of SENSE.STEAM in tangible ways (see Deliverable D4.1 for more details on the set up of the STEAM labs).

The main accomplishments after the project's first year can be briefly summarised as follows:

- Shaping the Essence: The early stages of the project were dedicated to shaping the core, the heartbeat that pulses within the 'SENSE.STEAM' methodology.

This foundational document, both theoretical and practical in nature, will serve as a guide for the implementation and co-creation trajectory across the project towards a common goal in the next two years.

- Harvesting insights: Recognising the value of informal knowledge, the project seeks to capture the wisdom and nuance that often elude formal documentation. These insights, gathered from different corners of the STEAM education ecosystem, provide a holistic understanding of the dynamics of the field.
- Identifying gaps: through the gaps between policy aspirations and practical realities in STEAM education identified by the project, the methodology aims at bridging these towards tangible outcomes while improving the effectiveness of classroom practice.
- Grounded in practice: The strength of the project lies in its connection to existing practices, frameworks and bodies of knowledge. It doesn't reinvent the wheel, but refines it, turning established wisdom into a transformative force.
- Listening to stakeholders: The diverse needs of different stakeholders are central to the development of SENSE.STEAM and has listened to the voices of students, businesses, education providers and other stakeholders and will continue to do so in the next years through implementation, co-creation and policy development activities.
- A multifaceted perspective: SENSE.STEAM thrives on diversity, recognising the importance of a multi-perspective approach with social inclusion and gender equality at its core. This collaborative spirit culminates in a co-creation process where stakeholders help to shape the educational landscape they envision.

3. Policy recommendations

This section presents the different policy recommendations that have emerged from the activities and discussions held during the first year of the project. Our first policy recommendations are organised in four main policy topics.

3.1. Topic 1: STEAM counters skills shortage & boosts STEM careers

STEAM addresses skills shortages and promotes STEM careers. SENSE. prioritises inclusive STEAM education, fostering diverse interests in science to develop skilled scientists equipped to address societal challenges such as digitalisation and climate change.

The project bridges education and work through innovative pedagogy that businesses and R&I stakeholders can implement, guided by a final Roadmap, with the

digital hub enhancing seamless learning. It also empowers researchers and strengthens Europe's innovation by sharing knowledge and skills and stimulating interdisciplinary jobs and validates increased competence. Business insights enrich employability.

SENSE. advocates the integration of STEAM skills into vocational training, involving all stakeholders. Business representatives highlight 'power skills' that combine arts and sciences for flexibility and innovation. Through STEAM and SENSE., we drive innovation and sustainability in Europe.

> SENSE. policy recommendation 1:
> Integrating STEAM principles in vocational education and national vocational curricula
> Stakeholders: all stakeholders involved in developing, delivering, accrediting, and receiving vocational education and training

At EU level, we strongly advocate the integration of STEAM into vocational education and training. This involves embedding STEAM principles in curricula and programmes. Educational institutions, industry and professional bodies should work together to implement this. VET stakeholders – educators, employers and policy makers – need to contribute. By integrating STEAM competencies into vocational education and training, we aim to equip learners with holistic skills that combine technical skills with creativity. We will work further in the project to define and structure the way to achieve this goal.

Recognition of 'power skills' or 'transferable skills' by employers from businesses or the public sector is essential. Leadership, inclusion, flexibility, critical thinking, problem solving, personal growth, wellness and time management are key competences that can be acquired and further developed thanks to STEAM education, bridging scientific and artistic skills. STEAM education will provide individuals and companies with strengthened adaptability and creativity supporting Europe's competitiveness and growth.

> SENSE. policy recommendation 2:
> Enabling innovation and adaptability: integrating STEAM into workforce development for industry and the public sector by recognising development and implementation of STEAM practices as a competence or skill on its own
> Stakeholders: Labour market (industry and public sector, unions, etc.), public authorities in charge of competence frameworks.

We propose a policy shift for industry and the public sector to integrate STEAM into workforce development programmes and recognise the development and implementation of STEAM practices as a competence on its own that can be valued, acquired, developed, transferred, along the learning continuum and in the working life.

Competence frameworks such the European Skills, Competences, Qualifications and Occupations framework should embed specific STEAM competences and these should be promoted not only in education settings but in businesses. This transformative approach fosters transdisciplinary thinking, encourages collaboration and triggers both technological innovation and soft skills development, and eventually support a value chain between education and the working life of European citizens.

3.2. Topic 2: STEAM fosters gender equality and social inclusion

We advocate an enriched STEAM approach that includes citizen science and artistic interventions to enable social inclusion and gender equality. SENSE.STEAM embodies this, with growing evidence of the transformative power of the arts in STEM education. The merging of arts-informed community science and citizen science is an example of our innovation and calls for an inclusive research ecosystem that promotes accessible community activities.

Open Science policies at EU level reflects this by democratising knowledge through citizen science. Central to this endeavour is the strengthening of the participation of women, girls and vulnerable groups, minorities and refugees. This synthesis intertwines STEAM, citizen science and inclusivity, reflecting the multifaceted ethos of SENSE.STEAM for a more equitable future.

SENSE. policy recommendation 3:
Promoting equity and innovation by integrating Arts and Citizen Science practices in STEAM Education
Stakeholders: all STEAM beneficiaries and STEAM stakeholders are concerned

To promote gender equality and social inclusion, we advocate an enriched composition of STEAM that includes citizen science and artistic interventions. SENSE.STEAM demonstrates this by bringing together artistic community science and citizen science. Socially inclusive STEAM equips European educators and researchers with innovative methods that enable innovation creativity, adaptability and accessibility. This initiative also promotes accessible community activities. European research policies reflect societal goals, integrate citizen participation and democratise knowledge through Open Science.

SENSE. policy recommendation 4:
Promoting a broader understanding of citizen science practices into national and international science funding policies to enable gender equality and social inclusion.
Stakeholders: DG R&I public authorities in charge of developing R&I policies, funding bodies

Redefining citizen science is critical, as the traditional science approach falls short in addressing gender dynamics and social inclusion. This shift towards inclusivity is key to achieving meaningful progress and transformative change in deploying citizen science activities through R&I projects and activities. By broadening our perspective on citizen science, we empower women and marginalised groups and foster social cohesion. We recommend explicit STEAM perspective of citizen science addressing gender equality and social inclusion into updated open science policies and promoting such activities through funding policies, via earmarking of funds or through revised funding selection procedures.

3.3. Topic 3: Leveraging STEAM for Future-Making Policy Areas

The integration of SENSE.STEAM creates opportunities for students to lead real-world enquiries that speak directly to their concerns and the wider societal challenges they will contribute to address and res. Using a range of hybrid (self-) learning tools for local citizen science activities, students use data and relevant EU policies to explore impactful solutions. The comprehensive framework encompassing The New European Roadmap to STEAM Education, coupled with the dynamic digital and real-world STEAM Academy and Labs, as well as the inclusive Digital Hub and its range of application and implementation tools, synergistically drive a seamless transition into the workforce, fostering each stage of the learning pathway.

Nurtured by the insights and tools on spatial configurations provided by the SENSE. project, STEAM is poised to make a substantial contribution to one of Europe's most important forward-looking visions - the New European Bauhaus Initiative. This is a crucial step towards shaping a visionary Europe that seamlessly weaves green policies and digitalisation into educational design. This holistic approach will widen access to science learning and enrich the wellbeing and creativity of students at school, employees at work and citizens. STEAM can be a major driver in the transformative movement that intersects with key policy areas - the Green Deal, digitisation, health, work readiness and the New European Bauhaus.

SENSE. policy recommendation 5:
Unfolding the transformative potential of different STEAM configurations on policy level
Stakeholders: policy makers at EU and national levels working on policy areas and initiatives such as the Green Deal, digitalisation, health, work readiness and the New European Bauhaus

The STEAM approach combines STEM and the arts, which creates complexity. It faces two central tensions: i) The traditional interpretation restricts the arts to

complementing STEM's economic agenda, neglecting their true potential. ii) This approach obscures the broader transformative role of the arts across disciplines, overlooking profound impacts.

Curricular structures also present barriers, in particular regarding the inclusion of non-traditional subjects, shifting curricula towards practical dimensions, and merging of academic, artistic and vocational fields, creating clashes of expertise.

A limited view underestimates the power of STEAM. A more powerful idea emphasises how the arts and humanities redefine knowledge, expertise and collaboration. Embracing 'doing STEAM' emphasises process and fosters diverse inquiry.

Unleashing the potential of STEAM means to
- ✓ Embrace a 'craft' approach that combines thinking and doing.
- ✓ Challenge the concept of expertise as an archive, valuing authorship, and performance.
- ✓ Elevate the role of the body, bridging the gap between brain and body.
- ✓ Prioritise sensory perception, exploring the impact of attention.
- ✓ Recognise the transformative power of STEAM beyond mere addition.

STEAM becomes a dynamic framework that breaks down disciplinary boundaries, encourages experiential learning and reshapes ways of understanding. Shifting the focus from 'what we know' to 'how we know' empowers students and promotes transformative education.

SENSE.STEAM aims to apply and evaluate its approach in different contexts through STEAM Labs. These Labs will focus on four key thematic areas: Green Deal, Digital, Health and Work Readiness. Through this application, the project aims to uncover the unique pedagogy that emerges, including co-created learning sequences and educational materials that meet the needs of participants. In addition, a key aim is to measure the impact of this pedagogical approach on stakeholders' performance in STEAM education.

3.4. Topic 4: STEAM promotes educational innovation across the learning continuum

STEAM brings together different disciplines and methodologies, creating a dynamic platform that fosters curiosity and engagement across the learning continuum and at all levels of ability. At the heart of SENSE.STEAM are the core themes of 'sensing' and 'embodying'. By incorporating sensory experiences and embodied learning practices, SENSE.STEAM empowers learners to explore concepts through hands-on engagement, connecting theory with tangible experiences. This enriches education with multidimensional perspectives, promoting deeper understanding and long-term impact.

In addition, the influence of spatial configurations is a critical consideration. SENSE. uses innovative spatial design to enhance learning environments, fostering creativity, collaboration, and holistic engagement. Recognising the importance of the local context, STEAM provides education that is relevant and accessible to communities, allowing for seamless integration into existing curricula. This multifaceted approach creates a holistic and locally relevant learning experience that drives educational innovation across the learning continuum.

> SENSE. policy recommendation 6
> Fostering effective STEAM adoption: building common ground through co-creation and stakeholder dialogue
> Stakeholders: educators and trainers in schools, higher education, world of work and public bodies.

To facilitate the successful integration of STEAM (Science, Technology, Engineering, Arts and Mathematics) in education and careers, we propose a targeted policy recommendation based on co-creation and dialogue. This recommendation is tailored to educators and trainers in schools, higher education, the world of work and public institutions, with the aim of creating mutual understanding and empathy, empowering their STEAM journey and triggering structural change. The key to achieving this is Building Common Ground. Gathering existing knowledge and introducing the basic concepts of STEAM and SENSE.STEAM in a "STEAM DNA workshop" as a foundational step (Step 0) before full implementation. This workshop can serve as a collaborative platform where stakeholders collectively define their STEAM needs. Rather than seeking a single, definitive definition, the focus is on recognising synergies between different perspectives for a common learning goal.

The objectives of such a workshop can be:
- ✓ Identify agreements and disagreements: Encourage stakeholders to identify areas of agreement and disagreement about the potential of STEAM.
- ✓ Identify organisational entry points: Enable stakeholders to identify specific entry points for integrating STEAM into their respective organisations.
- ✓ Facilitation techniques: Provide guidance on effective facilitation techniques that encourage open dialogue and engagement.

Possible Key Workshop Questions to provide participants with key questions to stimulate thoughtful discussion:
- ✓ Build on existing knowledge: Share something participants already know or would like to learn about STEAM.
- ✓ Envisioning change: Encourage participants to outline the changes they envision as a result of implementing STEAM.
- ✓ Addressing Challenges: Identify critical challenges or barriers to incorporating STEAM within the current organisational context.

Through the STEAM DNA workshop, educators, trainers and stakeholders will be better equipped to work together to navigate the complexities of STEAM integration. This approach promotes a holistic understanding of STEAM's potential, fosters collaboration, and sets the stage for informed, targeted implementation strategies. This recommendation builds on the lessons learned and experience from the project' own STEAM DNA workshop documented in Deliverable D3.1, which can be used as inspiration for organising similar workshops in different multistakeholder settings.

> SENSE. policy recommendation 7
> Implementing STEAM sustainably through collaborative networks and partnerships
> Stakeholders: Educational institutions in the learning continuum

This policy recommendation underlines the crucial role of educational institutions within the learning continuum. Recognising their deep commitment to innovation and interdisciplinary cohesion is paramount. Aligning values such as accessibility and equity with the STEAM and SENSE. vision enhances the resonance of this initiative.

An important proposition has emerged from the SENSE. stakeholder analysis (Deliverable D3.4) - the forging of robust connections between institutions and families. This collaborative endeavour enriches the learning process by harmonising home and school experiences, thereby amplifying the educational impact.

The rise of cross-curricular workshops is noteworthy. These workshops act as a bridge between the arts and sciences, fostering authentic and experiential learning. Such an approach cultivates inventive thinking and innovative problem solving.

At its core, this policy recommendation aims for an uninterrupted educational journey that fosters the gradual development of students. Collaborative networks and partnerships promote inclusivity, workshops ignite inventive expression, and a seamless trajectory fosters comprehensive growth.

In summary, this recommendation drives educational institutions to lead transformative change in the educational landscape. Encouraging collaboration, facilitating cross-disciplinary workshops, and creating a seamless educational pathway align strongly with the mission of SENSE.

4. Conclusions

In conclusion, this policy brief is an overview of various evidence-based insights and recommendations to inspire policymakers, stakeholders, and educators. Its overarching goal is to promote the integration of STEAM approaches into education policy and practice, and to foster innovation and collaboration across the learning ecosystem. Aimed at a broad readership, our recommendations are tailored to a wide range of stakeholders who are key to advancing European STEAM education.

At this early stage in the project these policy recommendations should be refined, tested and developed further, discussed and revised in feedback loops with policy and decision makers and through the evaluation of the STEAM Lab activities. More policy recommendations will arise from the future work and in particular pertaining to space and social inclusion and gender equality. We aim to provide tools to operationalize our policy recommendations through our Roadmap and its Digital Hub, with a dedicated Catalogue of policy recommendations tailored to the different STEAM beneficiaries and considering different levels of STEAM maturity and scale, to be delivered at the end of the project.