SENSE. The New European Roadmap to STEAM Education

D4.2 – Report on the implementation activities of the STEAM Labs

October 2024

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Abbreviations and acronyms

Abbreviation or acronym used in this document	Explanation
DECP	Dissemination, Exploitation, and Communication Plan
DoA	Description of Action
GEYC	Group of the European Youth for Change Consortium Partner and STEAM Lab host, Romania.
HB	Hawkins Brown Architects Ltd. Consortium Partner and STEAM Lab host, UK.
HVL	Høgskulen på Vestlandet (Western Norway University of Applied Sciences) Coordinator and STEAM Lab host, Norway.
ODY	Odyssea

	Consortium Partner and STEAM Lab host, Greece.
PHW	Pädagogische Hochschule Weingarten (Weingarten University of Education) Consortium Partner and STEAM Lab host, Germany.
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEM	Science, Technology, Engineering, Mathematics
UB	Universitat de Barcelona (University of Barcelona) Consortium Partner and STEAM Lab host, Spain.
UEdin	University of Edinburgh Associated Partner and STEAM Lab host, UK.
WECF	Women Engage for a Common Future Consortium Partner and STEAM Lab host, Georgia.
WP	Work package

Glossary

Term	Definition used or meaning in the SENSE. project	Reference or source for the definition if applicable
Civil Society Organisation	A civil society organization (CSO) is any non-profit, voluntary citizens' group which is organized on a local, national, or international level. Task-oriented and driven by people with a common interest, they perform various services and humanitarian functions, bring citizens' concerns to governments, monitor policies, and encourage political participation at the community level.	D3.2
Communication	Informing on and promoting the project's activities and results among the citizens, media and stakeholders	D2.2
Digital hub	An online repository of learning materials to enable and empower learners to carry out STEAM activities	D7.2

	tested and validated in the SENSE. project	
Dissemination	Sharing research results with the scientific community, commercial players, civil society, and policymakers	D2.2
Exploitation	Taking action to use the project results for commercial purposes, to tackle societal problems or in policymaking	D2.2
Implementation Activity	Implementation Activities are any activities carried out by the STEAM Labs that implement the unique SENSE. methodology. The project's implementation activities in the labs reach potential change agents and enable them to become advocates for STEAM.	D3.1
Inclusion	A process that helps to overcome barriers limiting the presence, participation and achievement of learners. In the field of education, "inclusion is regarded as an extension of a comprehensive approach to education, in which children's rights and social justice are positioned at the forefront of educational thinking; one that goes beyond tolerance and compensating for pupils' perceived 'disabilities'". Accordingly, inclusion encompasses the idea of recognising and appreciating diverse perspectives and contributions.	D3.3
Learning Sequence	A *learning sequence* refers to an activity of a STEAM Lab that focuses on communicating, teaching, or researching a topic or issue (in whatever form). In this context, characteristic *practices* are used, that involve, activate, or inform participants and can be content-centred, teacher-centred or equally focus on social interaction or refer to open learning environments.	New: Chapter 5.1

Local Implementation Strategy	Concrete strategy each STEAM Lab drew for their implementation process across the kinds of events: launch events, endurance events, atelier events. The strategy is based on considerations how the SENSE. activities will be adapted according to the needs of the local social, cultural, geographical, and economic context.	New: Chapter 4.1
Practice	SENSE. *practices* involve, activate, or inform participants and can be content-centred, teacher-centred, or equally focus on social interaction or refer to open learning environments. The development, testing and documentation of such SENSE. practices are important goals of the project, as characteristic practices are used in the context of learning sequences.	New: Chapter 5.1
Roadmap	Roadmap is a strategic planning technique that helps to communicate to all the stakeholders of STEAM education the SENSE. project's goals, and their respective major deliverables over time which also supports them in defining their respective action plans. It is a step-by-step process for providing an implementation for future STEAM education. There are three phases of the Roadmap: Awareness, Action, and Advocacy.	D2.3
SENSE. / SENSE. project	The ambition of the SENSE. project is to make a significant contribution to STEAM education in Europe and to drive paradigmatically new ways of learning and teaching, by elaborating a future-making pedagogy whereby science and art come together to create future-making education, support students' ability to ask questions, develop empathy and critical thinking, and make learning meaningful.	D3.4

SENSE. stakeholder	A stakeholder in the project SENSE. is any person, organisation or group that is affected by or who can affect the outcomes of this project.	D3.3
SENSE. methodology	The SENSE. methodology, comprising a dedicated educational model and its pedagogy, with i) STEAM inquiry, ii) citizen science and art practices, iii) learner centredness and iv) reflective feedback as its building blocks	D1.1
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.	D2.7
STEAM Lab	A specialized learning environment for the implementation of SENSE., featuring diverse participant panels and addressing specific needs in varied social, cultural, geographical, and economic contexts.	D7.2

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-centred 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., 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

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Executive Summary

This report "D4.2 Report on the implementation activities of the STEAM Labs" summarizes the implementation phase of the SENSE.STEAM methodology in the 12 STEAM Labs and collates initial findings on activities and participants. The intention is to show on what the implementation phase was built, how it went, and what we learned from it.

The **background** of the implementation phase laid in WP3 and its components, such as the reports covering practices, stakeholders, and the unique SENSE. methodology as well as accompanying tools such as the pool of practices or the SENSE. manifesto (Chapter 3). In initial phases the STEAM Labs set up launch events and conducted forms of needs assessments as portrayed in the previous deliverable D4.1 – the results of which are reflected in Chapter 2.

All STEAM Labs developed a local **strategy** affected by their context and conditions and based on the overall objectives to implement SENSE. in three progressive levels Awareness – Action – Advocacy. The resulting activities can be divided into learning sequences and dissemination actions & discussions. Their implementation was supported by different instruments, i.e. specific meetings, guidance documents, and reporting mechanisms including flexible templates.

A **total** of at least 244 implementation activities were carried out, of which 145 were categorised as learning sequences or part of those. As counting recipients was not feasible within some of the larger dissemination actions, exact participant data is available for 188 of the implemented activities, summing up to a total of 4302 involved stakeholders (Tab. 11).

As the **learning sequences** represent the actual application of SENSE., they were of particular interest. Influenced by the objectives, target groups, and conditions, and supported by an initial workflow of designing SENSE. sequences (Fig. 19) along with what WP3 had provided, the STEAM Labs applied

- 13 different activities labelled as learning sequences in 98 implementations.
- 17 different activities labelled as practices in a total of 63 implementations.

while reporting their implementation and sharing experiences with the WP4 coordination team. Some of the learning sequences deployed are highlighted (Tab. 9), others also showed potential, and all of them contributed to a revised and elaborate process of defining and designing SENSE. sequences for the project's future as outlined in Chapter 5.1. The simplified workflow contains of a four-step process: framework – needs – practices to learning sequence – reflection.

The SENSE. **beneficiaries** as outlined in the DoA (part B) showed an overall acceptance of the (parts of) learning sequences and often reacted with proactive engagement. Albeit Chapter 5.2 addresses the diverse participants, detailed information about impact is to be found in the evaluation report D4.3.

Overall, the activities successfully took place in various conditions involving diverse participants and settings. Active engagement with space, inclusion especially of girls and women, and collaboration in creative processes were evident. Implementations fostered direct sensory connections to the world and highlighted interdisciplinary perspectives. The phase of the STEAM Labs successfully ensured applying the underlying methodological principles, confirming the potential of the

SENSE.STEAM approach and harvesting results to further improve elements and processes towards the final product.

A special highlight is the "**Lab stories**", where the individuality of the various places is depicted and even complemented by featured videos of facilitators presenting their STEAM Lab. (cf. 2.3).

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1. Introduction

The SENSE. project aims to provide a flexible roadmap for future-making STEAM education across Europe. To achieve this, the transformative *SENSE.* methodology, which harnesses scientific and artistic inquiry with reflective feedback, has been elaborated in preparation for the STEAM Labs. These implemented the unique methodology to develop materials and actions, and to gather reflections and evaluation results to contribute to the production of the *New European Roadmap to STEAM Education* and its supporting tools, especially the learning companion and the digital hub. The intention behind the long implementation phase is to guarantee that we are creating real, meaningful impact and to test the applicability of the model by replicating across countries, institutions, target groups, and contexts.

1.1. Purpose of the document

This document "D4.2 Report on the implementation activities of the STEAM Labs" aims on sharing and summarizing how the different labs that were established across Europe implemented SENSE., and what results and reflections could be derived from the implementation phase. Read more about the content in Chapter 1.3. In the context of the SENSE. project, this report is part of work package 4 "STEAM Labs", builds on Work package 3, follows the report about the launch of the STEAM Labs (D4.1) and is highly related to the parallel report about the evaluation within the labs (D4.3). While this report focuses on summarizing the implementation process and on initial observations and conclusions, the evaluation report mentioned above concentrates on impact and recommendations.

The STEAM Labs fulfil several functions within the SENSE. project. While this report mainly shows *what* the labs have done and compiles the findings about activities and participants, the results and outcomes that have resulted from the implementation are largely part of other corresponding reports. Thus, this report often refers to the specific deliverables. The forthcoming deliverable D4.4 compiles recommendations from the implementation phase in relation to the planned final products of the project, namely the roadmap and associated materials, guidance, and tools. Other processes go beyond the STEAM Labs, such as the development of educational material, and are therefore addressed in the roadmap work package WP7 itself.

1.2. Intended readership

The document and its annexes are primarily designed for all those involved in the STEAM Labs and the consortium itself. Additionally, it intends to report our implementation progress and initial outcomes to the European Commission.

As its dissemination level is public and it is foreseen to embed the deliverable on the website, it is also intended for any stakeholders that are interested in the project's process, particularly in the real-world implementation phase across the continent.
It might be of particular interest for teachers and educators or representatives from institutions and organizations in the fields of formal or nonformal education.

1.3. Structure of the document

This deliverable consists of six chapters.
The first chapter collates basic information about the document itself. The second chapter "The STEAM Labs" describes the labs and refers to their individual stories, while the chapter after that summarizes the background given by the methodology along with further important considerations, especially the results from the needs assessments.
Chapter "4. Practicing SENSE." summarizes information about the implementation strategy and guidance to then focus on describing the variety of activities carried out. The fifth chapter outlines the initial results of the implementation phase, especially analysing what a SENSE. sequence is. The final chapter "6. Implementing SENSE.: Results & Conclusions" collates the results of the implementation phase.

In short, the report is about what the STEAM Labs are, what they did and with whom, and what we learned from the implementation.

1.4. Process of the deliverable

At first, the immense number of possible inputs from the implementation phase was structured in a collaborative effort, leading to a draft version of the content. Preliminary inputs could be drawn by the end of the implementation phase. After several clarifications and strategic feedback, the previously envisaged plan of co-contributions was revised to a more comprehensive and (deliverable) lead driven version. The new overall draft was supported by valuable inputs from the partners WECF, GEYC, Creda, and HVL, and followed the key structure of
- Describing the STEAM Labs
- Summarizing SENSE. so far
- Implementing SENSE. (description of activities)
- Results & Reflections.

After the implementation phase, extensive analysis of the STEAM Labs' reports as well as a thorough collation of implemented activities and corresponding materials along with indispensable feedback from many collaborators led to a final draft – while producing a multitude of data and file collections, the value of which will become apparent in the future. The two main challenges were balancing the huge amount of data and potential information to be concise and representative, and the relationship between the deliverable at hand and the parallel processes connected to simultaneous reports that had to be considered permanently along the process.

2. The STEAM Labs

This chapter describes the STEAM Labs, their intentions, and the importance of the implementation phase for the SENSE. project. After recapitulating the first actions in Chapter 2.2, the individual lab stories, where every lab is portrayed, are being told in Chapter 2.3.

2.1. Description

The set of STEAM Labs are where the SENSE. project's implementation activities took place in. This serves the purpose of establishing requirements for practical implementation of the SENSE. methodology, thus followed the goal to show the model's applicability, replicability, and transferability in diverse settings across Europe. The STEAM Labs integrated a highly developed co-evaluation strategy within the implementation process, assessing the impact of SENSE. on institutional and interactional level. Potential change agents were reached by the bandwidth of actions carried out, for them to produce valuable feedback on the implementation itself and eventually to enable them to become potential advocates for SENSE.

Additionally, the cross-cutting issues social inclusion and spatial design were mainstreamed in implementation processes (cf. 4.6) to analyse their transformative power in the context of STEAM education and draw conclusions on how specific strategies, considerations, and tools may be integrated successfully in the practical execution of the SENSE. educational model.

The STEAM Labs were to implement the SENSE. methodology in three progressive levels Awareness – Action – Advocacy, outlined in the implementation strategy (cf. 4.1). Along this implementation, materials and actions were further developed while simultaneously evaluating their impact, especially on the four key thematic areas *Digitisation*, *Work Readiness*, *European Green Deal*, and *Health*. Lastly, the labs acted as 'experience sharing' part of building a hybrid collective of multi-stakeholders' collaboration and communication.

The STEAM Labs are temporary, institutionally anchored, and framed as "Living Labs", an established model for engaging communities and stakeholders, to progressively implement and evaluate the SENSE. methodology.

2.2. Setting up STEAM Labs

Launching the STEAM Labs
As outlined in the previous report D4.1, the STEAM Labs were set up in a constituting process of needs assessments, launch events, and supporting actions such as guidance, dissemination, and collaboration. Particularly the launch events were foreseen as the first sort of events outlined in the Description of Action (DoA). These launch events of the STEAM Labs were analysed and documented in D4.1. The 11 lab launches consisted of one event or a series of events involving a variety of stakeholders. All Labs worked with teachers, and most (9 out of 11) invited youth to their launch events. 6 Labs involved employers and 4 involved policy makers. Their needs are known to the organizers through needs assessments or from analysing previous experiences. Participants were invited through personal invitations and social media by 8 labs. In addition, newsletters, media, posters and website announcements were used to announce launch events.
As report D4.1 concludes, the "launch events built upon the needs of stakeholders […]. They are an important step to engage stakeholders in a meaningful way in the implementation of the labs, leading to further uptake and sustainability." (p. 26).

Supporting Structures
The following documents were made available to the partners to prepare their launch events in June and July:
- A guidance document for launch events has been set up with practical information. It provides a checklist of practical issues to organize and helps to streamline the events and avoid double work.
- The consortium members conducted a Needs Assessment before, during, or after the launch event to ensure that the lab activities are relevant for the target groups. The needs assessment is an integral part of the SENSE. methodology and can be regarded as a cross-lab activity.
- To work efficient and streamline the processes in the living labs, an invitation letter was drafted for partners to adapt and use for their launches.
- A presentation template was prepared for the STEAM Labs to adapt and build upon during their launch events. It contains a general presentation of the project in simple language targeted at a wide range of stakeholders who are not familiar with the topic. Partners are invited to add slides about their specific labs.

In addition to the guidance above, monthly meetings were organized from March by the WP lead HVL to discuss the process of the STEAM Labs, share which and how practices were implemented and provide guidance and support where needed.

Difficulties and Recommendations
The consortium is very diverse and offers a wide range of settings and approaches in lab launches. Often reality is divergent from planning. In most cases, launch events planning was subject to the schedule and limitations of external stakeholders and institutions. Since the launch events are extracurricular activities, it was challenging for some of the STEAM Labs to recruit participants who were motivated to show up. Due to these circumstances, some institutions had to rearrange their plannings and for example went for soft launches, carrying out the different activities as several events, partly embedded in existing structures. In settings with participants from disadvantaged communities, extra efforts were needed to ensure consistent participation.

It turned out that flexibility, diversity, and the ability to adapt to diverse settings were crucial for the success of the lab launches. Due to the needs-based approach, the interests and needs of the participants were addressed in meaningful and engaging ways. Integrating the SENSE. activities into the host institutions' structures will ensure the activities' sustainability and endurance.

2.3. Listening to the Stories of STEAM Labs

The journey of the STEAM Labs is both unique to each organisation and a shared experience across different contexts, participants, and stakeholders. While each site worked towards the common goal of implementing STEAM education using the SENSE methodology, they also focused on awareness raising, prototyping, evaluation and sharing results.

This chapter highlights the stories of different STEAM Labs. For each lab, you'll find basic information and a summary of their progress. In addition, some of the facilitators have recorded their personal experiences, giving you the opportunity to hear their insights directly.

You can find these interviews on the STEAM Lab page of the SENSE website: https://sense-steam.eu/steam-labs/

STEAM Lab #1 – "In*Visible" – CREDA

Figure 1: Caviardage Activity at CREDA's STEAM Lab

Organisation: CREDA (CREDA onlus)
Location: Monza, Italy
Target group: children, youth, school teachers, public

CREDA held a big launch event with numerous workshops and a big outreach by being part of the Monza Park Festival in September 2023 (D4.1). Their activities often addressed inclusion while they continued to involve very different stakeholders, focusing on future making as well as mutual learning and knowledge exchange (D6.2). Further activities were carried out under the umbrella topic "In*Visible".

STEAM Lab #2 – "Inclusion meets vocation" - ODY

Figure 2: Gender Portraits Activity at ODY's STEAM Lab

Organisation: ODYSSEA (Odyssea ontisi astiki mi kerdoskopiki eteria)

Location:	Athens, Greece
Target group:	young people from vulnerable groups

ODY invited their students, businesses, and VET schools to their launch event (October 2023) containing of an icebreaker, a presentation, and discussions (D4.1). The Greek side was considered an inspirational case for inclusion in D6.1 as they offer interventions and resources for vocational and life-skills training and employability services to refugees. All groups they worked with lacked community advocacy and resources. The early activities mainly addressed gender and revealed stereotypes, while inclusive teaching activities were important due to existing language barriers & cultural barriers. The organization goals related to SENSE. aim on equal participation and future making (D6.2). In the further process, ODY implemented various activities while especially focusing on adapted versions of gender related learning sequences.

STEAM Lab #3 – "Extraterrestrial science centre" – VilVite

Figure 3: Extraterrestrial Life at VilVite's launch event

Organisation:	VilVite (Bergen Vitensenter AS)
Location:	Bergen, Norway
Target group:	families, youth, schools, teachers, employers

VilVite launched in October 2023 in a common event with HVL including discussions and learning activities with schools (D4.1). Further, the science centre implemented a series of identical activities ("Extraterrestrial Life") with multiple school classes.

STEAM Lab #4 – "Making Together" – Velvet

Figure 4: Creating Slime in a fun way at Velvet's launch event

Organisation: Velvet (Velvet OÜ)
Location: Tallin, Estonia
Target group: general public

Velvet's launch event in October 2023 was foreseen to consist of discussing STEAM with students and stakeholders (D4.1). Future activities implemented in Estonia all sort of related to open processes of collaboratively making and designing.
Listen to Velvet's STEAM Lab story on the website!

STEAM Lab #5 – "Bringing SENSE. to higher education" – PHW

Figure 5: Colour Pendulum activity at PHW's STEAM Lab

Organisation: PHW (Paedagogische Hochschule Weingarten)
Location: Weingarten, Germany
Target group: university students, educators, academic staff, public

PHW had planned their launch event for October 2023 with a presentation and a stakeholder discussion along with implementing the activity "Drawing Sounds" (D4.1). After rearrangements, a soft relaunch event along with setting up a STEAM seminar for university students embedded the implementation, while a variety of activities was tested and reflected on with different beneficiaries.

Listen to PHW's STEAM Lab story on the website!

STEAM Lab #6 – "Youth in a bandwidth of activities" – GEYC

Figure 6: Gender Roles activity at GEYC's STEAM Lab

Organisation: GEYC (Group of the European Youth for Change - GEYC)
Location: Bucharest, Romania
Target group: 13-35 years young people, youth workers, teachers

The launch event of GEYC's STEAM Lab in October 2023 wanted to offer live and digital presentations to students, local authorities and press (D4.1). The simultaneous report D4.3 that focuses evaluation portraits the Romanian site's STEAM Lab more in-depth. The young participants (13 to 19 years old) across Romania had different backgrounds and faced various local challenges while the bandwidth of learning sequences they were involved in often made them take agency of their learning – they involved feedback & adaptation, equal participation and co-creation & cooperation (D6.2).

STEAM Lab #7 – "STEAM – inclusive garden" – UEdin

Figure 7: Plant and Bake Sale at UEdin's STEAM Lab

Organisation: UEdin (University of Edinburgh)
Location: Edinburgh, Scotland // United Kingdom
Target group: university students, educators, researchers, academic staff, public

The story so far:
The STEAM Lab at UEdin did a soft launch in August 2023 involving teachers and policy-makers in conceptual discussions ahead of the STEAM implementation activities (D4.1). The D6.2 already shared UEdin's implementation of a course on gardening that inherited numerous sessions with the same group of teen students from low-income backgrounds. The sensorial experiences and co-creation & cooperation surpassed the roles of other inclusive indicators (D6.2).

Listen to UEdin's STEAM Lab story on the website!

STEAM Lab #8 – "STEAM for community building" – WECF

Figure 8: Article from the Future activity at WECF's STEAM Lab

Organisation: WECF (Women Engage for a Common Future - Georgia)
Location: Tbilisi & Akhmeta, Georgia
Target group: girls & women, policymakers & decision-makers, youth, public

The Georgian site's launch event containing a workshop with teenage girls, policy makers and representatives from artistic & cultural institutions as well as press was done in September 2023 (D4.1). The report D6.1 also mentioned WECF as an inspirational case for inclusion, as it backs a community of girls developing technological skillsets adapted to local contexts and needs, while maintaining to include global perspectives. The girls are limited by local poverty and traditional gender bias, making equal participation highly relevant for them as their STEAM Lab focused on cooperatively building technological solutions to address community needs (D6.2).

Listen to WECF's STEAM Lab story on the website!

STEAM Lab #9 – "Heat Chronicles and other Citizen Science" – UB

Figure 9: Heat Chronicles activity at UB's STEAM Lab

Organisation: UB (Universitat de Barcelona)
Location: Barcelona, Spain
Target group: university students, educators, researchers, academic staff, public

While UB did not do a formal launch, their launch was also considerably "soft", involving vulnerable youth, NGOs and teachers in citizen science actions/ trainings in the summer of 2023 (D4.1). These cs projects that address climate vulnerability in outdoor public spaces of disadvantaged neighbourhoods were already shared in D6.1. These continued in the lab phases, highlight co-creation, access, and identities, therefore making inclusion principal for most of the actions – more details about this are provided in D6.2.

Listen to UB's STEAM Lab story on the website!

STEAM Lab #11 – "About shadow, light, and spaces" – HB

Figure 10: Light and Shadow activity at HB's STEAM Lab

Organisation: H\B (Hawkins Brown Architecture Ltd.)
Location: London, England & Dublin, Ireland // United Kingdom
Target group: students, public, researchers

In July 2023, Hawkins Brown engaged students, teachers, educators into a STEAM workshop that involved discussions and presentations (D4.1). As shown in D5.2, HB is focusing on in-depth space testing in their STEAM Lab as they are experts on this, meaning they conducted the same activity in various spaces.

Listen to HB's STEAM Lab story on the website!

STEAM Lab #12 – "STEAMING into the future" – HVL

Figure 11: Soil Painting activity at HVL's STEAM Lab

Organisation:	HVL (Høgskulen på Vestlandet)
Location:	Bergen, Norway
Target group:	university students, educators, academic staff, public

HVL conducted multiple implementation activities with a magnitude of different participants, from university students to schools, employers and else. While being focused on work readiness and collaborating with other labs, huge effort was also put into dissemination.

Listen to HVL's STEAM Lab story on the website!

STEAM Lab #13 – "Collaborative STEAM at Le Louvre" – Louvre

Figure 12: Botanical Drawing activity at Louvre's STEAM Lab

Organisation: Louvre (Musée du Louvre)
Location: Paris, France
Target group: artists and art collectives, cultural organizations, families, students, public, researchers

The launch event was planned for November 2023, with the intention of gathering cultural professionals, teachers/ educators, and social workers to share the project and discuss opportunities and challenges (D4.1). The French site continued to offer early pedagogy programs about art-infused, sensorial and aesthetic STEAM activities as mentioned in D6.1.

Honorable Mention: "Collaborative STEAM at the Theatre of Research" – ToR

Organisation: FUNDUS THEATER/Theatre of Research
Location: Hamburg, Germany
Target group: children, youth, artists/ art collectives, public, researchers, cultural organisations

Figure 13: Imaginative inquiry at the Theatre of Research

We are pleased that artist and theatre maker Sibylle Peters from the Theatre of Research in Hamburg had joined the SENSE. project in 2024. Her expertise in participatory art has greatly nurtured our efforts to integrate cultural institutions and artists. Sibylle trained the SENSE. consortium in participatory live art, in particular at the project meeting in Bucharest in April 2024. Based on some of her established formats, SENSE. takes another step towards creating "spaces for the learning of science in relation to society" (DoA (part B), p. 15).

3. Points of Departure for the activity implementation

This section first outlines the key prerequisites and foundations for the implementation of activities within the project, i.e. the prospective beneficiaries and directions of actions as described in the DoA. A further key factor is the SENSE. methodology developed in WP3. Additionally, the section presents or recaps the guidelines for data collection and analysis, as well as the concept and results for the needs assessment process.

3.1. The SENSE. Methodology

The SENSE. methodology includes thoroughly assessing stakeholder needs and challenges, collating knowledge across the consortium and its partners while also gathering practice experiences for the implementation phase, and most importantly the unique SENSE. methodology in the pursuit of a more inclusive, impactful, and effective educational paradigm as a theoretical foundation for the final product: The New European Roadmap to STEAM Education.

Core principles of the SENSE. methodology
The SENSE. methodology was collaboratively developed as a revolutionary approach to STEAM education. The report D3.5 outlines how the SENSE. framework expands the existing approaches and methodologies of STEAM education.

The SENSE. methodology is grounded in four building blocks (also often referenced as "pillars", see Figure 13) which were essential for designing SENSE. Sequences and STEAM Lab activities:
- Learner Centeredness: Learners as active creators of their own knowledge.
- Reflective Feedback: Feedback as driver for development and transformation of ongoing processes, involving introspection, interaction, personal encounters, empathy, and engagement – all expanded to human and non-human connections for a truly holistic perspective of being in the world.
- STEAM Inquiry: Combining artistic research and scientific inquiry within the framework of STEAM education, dissolving boundaries between disciplines end encouraging dialogue and collaboration instead. This shift from traditional STEM teaching to STEAM inquiry focuses on fostering a mindset of embodied cognition, empathy, co-creation, and growth to equip students with skills for innovation and adaptation in an uncertain world.
- Citizen Science & Art Practices: Enabling learners to liaise directly with the public as both science makers and science users – facilitating engagement with

scientists and artists, integrating artistic interventions, spaces, and approaches to explore and reflect together on matters important to community.
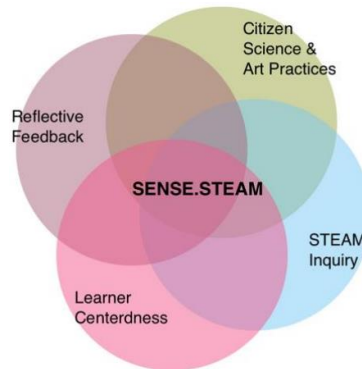
Figure 14: The four pillars of the SENSE. methodology.

A dynamic framework for practitioners and theorists – The SENSE. Manifesto
We reported in Worpackage 3 how the praxisinformed methodology exposed us to key questions regarding STEAM. A result of our collaborative efforts is the SENSE. Manifesto which we strongly understand as a living document, fulfilling multiple purposes. It can work, for example, as a framework for reflection, as a tool to reconceptualise existing educational designs or to nurture theoretical discussions.

All STEAM Labs adhered to the standards the projects data management plan (D1.3), as well as to the guidelines for ethics in the project's implementation phase, such as the ethical principles and ethics monitoring outlined in the ethics monitoring plan.

SENSE!	INVOLVE!	MAKE!	IMAGINE!	RELATE &CONNECT!
Encourage an open disposition to observe by engaging all the senses: What colours? What textures? What smells? What sounds can I/we perceive? Provide opportunities for perceiving, describing and sharing: *What is happening? What do others perceive on the whole sensory spectrum?*	Recognize backgrounds and lived experiences of all. Offer different spaces for contributions with different degrees of involvement and spend time to share them to make the activity more valuable to everyone. *What do I/you bring to this experience? What does this mean to me? And to you?*	Introduce opportunities to observe and share experiences through creative manipulation and hands-on processes: *What does it show? How does it change? What does it do?*	Come together to engage multiple logics and different ways of thinking: *What is this for you? How does this work? How could this work? How did others feel about it? How can I change the space to create different ways of thinking and doing?*	Stimulate drawing connections: *How does this relate with … other things?' What new ideas/ opportunities arise?*
SET OFF TO FIND OUT!	DISCIPLINE SWITCH!	COPRODUCE &ACT	BE DIVERSE & INCLUSIVE!	WORK WITH SPACE, PLACE AND TIME
Introduce a stimulus for an open and open-ended situation to be explored: *What matters to me? What matters to us as a community? What do I already know about this? What would I like to know about it? What do I want to start with?*	Encourage the integration of scientific, artistic, aesthetic, spatial, technological, social 'languages' for making sense of facts, phenomena, challenges.	Bring together learning and knowledge with the capacity to act individually and collectively on matters of common concern. Co-produce scientific evidence in joint research and learning processes; and on joint research within the learning process.	All along the whole learning process, question yourself if you are leaving anyone aside. Revise language and activities to be inclusive. Avoid the exclusion of any collective or group. And favour the involvement of underserved groups and communities.	Situate and connect question and activities in space and connect with the local context. Pay attention to the political dimensions of the space

Figure 15: The SENSE. Manifesto

3.2. Addressing Stakeholder Needs

As outlined in the D3.3 report, stakeholder involvement (= involvement of the beneficiaries the project aims to focus on) is crucial not only for the successful development and implementation, but also for the long-term uptake of the SENSE. project with its roadmap and methodology. Therefore, all STEAM labs are encouraged to use specific key messages to engage each stakeholder group according to their aspirations, trying in particular to address their needs and perspectives as identified in D3.3 and to be further addressed in local needs assessments.

Group key	STEAM Beneficiaries
A	Students aged from 13 to 18 years old, who need to make decisions on their future studies.
B	Students 19-25, who need to decide about further study and/or choose a professional career.
C	Girls who are afflicted by gender stereotypes limiting their access to science-related studies and professions.
D	Parents, who are involved in supporting the education and decision-making processes of their children at various stages of the educational life-course.
E	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.
F	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.
G	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.
H	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.
I	Policy makers and decision makers who derive education policies and curricula embedding STEAM throughout the learning continuum.
J	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.

Table 1: STEAM Beneficiaries in the SENSE. project

Process of Assessing Needs
All STEAM Labs were required to report on their needs assessment process, including any findings, insights, or recommendations they were able to gather. Some did this as part of the launch event and the associated reports, while others produced more or less comprehensive separate summaries.

All relevant reports were analysed in a multi-step process:
- Collecting all relevant reports. (Jan 2024)
- First and second inductive analysis: Two different coders analysed the needs reported for inter-coder reliability. Each one tried to categorize and summarize the shared needs across the different STEAM Labs, while also noting more specific needs. (Feb 2024)
- Deductive Analysis: Application of both category systems as deductive category assignment to the collated reports, in order to test the feasibility of both. (March 2024)
- Adapting the categories to suit all marked assessed needs, improvements in wording, consolidation of both systems, i.e. harmonization of categories. (April 2024)
- Presenting the harmonised categories as "Assessed Needs alias: What STEAM Labs identified as useful for setting up STEAM Education". (10.04.2024)

Further methods of Assessing Needs
The different labs used and recommended various methods of assessing needs. The list below is showing examples of assessment besides the methods provided in D4.1.
- Fast networking (HVL, Bucharest project meeting)
- Dixit *and* Photovoice feedback (Creda)
- Tree evaluation feedback (WECF)
- Louvre artistic/ open feedback (Louvre)
- "Public" Posters *and* "DasArts" feedback (PHW)

Assessed Needs in SENSE.
The five categories were split into the needs that address the design and conditions of successfully implementing STEAM education, and the needs that are more in-depth about the actual implementation of STEAM activities.
The two figures (Fig. 16 & Fig. 17) below collate the results.

DESIGNING

Consider Beneficiaries' Variety

❖ Make it for everybody!
Mitigating and healing (gender) inequalities, discrimination, stereotypes
❖ You & Others!
Sharing and (ex)changing individual opinions, perspectives, identities; fostering empathy; stepping into roles and other people's shoes
❖ Attach!
Conveying closeness and fostering involvement: icebreakers, talks & discussions, outreach events, (social) media

Accessibility

❖ Channels!
Different ways to engage in actions; digital & analogue tools involved
❖ Beyond borders!
Facilitating access beyond borders of pre-knowledge, language, time & place, resources, space...

Change Agents

❖ Networking!
Long-term networks and partnerships; committing science with society; involving public and raising awareness by promoting and disseminating
❖ Supporting!
Offering free guidance, training, support for teachers/ educators

Figure 16: Shared Needs across the STEAM Labs: Designing

IMPLEMENTING

Transdisciplinary all the way

❖ Integrative Content & Methods!
Making content, material, and methods transdisciplinary; allowing for STEM relations *and* art-integration; challenging the presumptions of theory focused and model-based science
❖ Shaping Structure!
Structural and curricular changes for space and time for future-making; showcasing real-life applications and landscape via experts and excursions that are backing, evaluating, and continuously improving the methodology

Tailored Practices

❖ Fitting, Activating, Quality!
Well-prepared, applicable/concrete, fun/interesting; participatory, hands-on, partial ownership (self-directed, -chosen); relatable, real, high quality
❖ Responsive & Personal!
Flexible, adaptive, spontaneous, individual; addressing and respecting emotions and sensorial perceptions
❖ Useful!
Perceived as useful for individual, curriculum, community, world; for teaching/learning, career (chances)/ work readiness, future/ sustainability
❖ More than you!
Collaborating, discussing, imagining, visualizing; role of space and surroundings thoughtfully and intentionally involved

Figure 17: Shared Needs across the STEAM Labs: Implementing

4. Practicing SENSE.

The following chapters are dedicated to describing the implementation activities. This term refers to any activities that were carried out by the STEAM Labs in order to use, test, apply, revise, or evaluate learning sequences or parts of them in workshops, discussions, or else – as well as actions making people advocates for STEAM, such as enabling them to develop/ conduct activities on their own or forms of dissemination.

The first chapter summarizes the general and local implementation strategy, while the second chapter explains the guidance along the implementation phase. The following

third chapter provides an overview of all implementation activities carried out – those are then further elaborated in the Chapters 4.4 (implementation activities that are (parts of) learning sequences) and 4.5 (implementation activities that are not). The last chapter shortly refers to the parallel efforts from WP5 and WP6.

4.1. Implementation: Strategy & Events

The implementation phase in the STEAM Labs aims to show the applicability, replicability, and transferability of the SENSE. model, while evaluating the implementation on institutional and interactional level and ideally reaching potential change agents to encourage them to become advocates for STEAM.
(DoA (part B), p. 11)

STEAM Labs address three main fields:
(1) Implementing the SENSE. methodology progressively,
(2) Developing materials and actions and evaluating their impact,
(3) Building hybrid collectives and produce resources and materials for the roadmap and its digital hub.

This report focuses on the implementation, while D4.3 is dedicated especially to the evaluation. The development of materials and actions as well as establishing the hybrid collective producing roadmap resources and feeding the digital hub can be seen as ongoing processes that will be focused on (and reported) in WP7.

The implementation of the methodology was foreseen to take place in three progressive levels as basis for the roadmap and digital hub we eventually produce:

Level	Description
Awareness: Building awareness and promoting STEAM.	In this awareness phase for organisations and individuals not yet engaged in STEAM, the approach gets explained and the added value to me, my organisation, and a future-making (European) community gets shown.
Action: Enabling action through educational practices to be tested and used by educators and students.	The action phase is for those who want to implement STEAM and look for partners, practices, experiences. It is about the educational model & pedagogy, about sharing and applying practices & experiences, and about finding & engaging partners.
Advocacy: Encouraging advocacy promoting STEAM.	The advocacy phase is for stakeholders who actively diffuse and promote STEAM. It is about the supporting tools & knowledge

	sharing, policy recommendations, collaborations, etc. This highly relates to the WP2, 5, 6, & 7.

Table 2: Overall implementation strategy – 3 levels Awareness, Action, Advocacy

Albeit the action phase surely seems pivotal, the awareness and advocacy phase can be just as addressed in certain events, depending on the forms of activities (see below) and the stage or experience (so called "STEAM maturity levels", DoA (part B), p.17) a lab and its participants possess.

Once established, the labs draw up a concrete local implementation strategy with considerations how the SENSE. activities will be adapted according to the needs of the local social, cultural, geographical, and economic context. Generally, this local implementation strategy contains three central elements:

Implementation Strategy Elements	Description
STEAM Lab Launch Event	An opening event bringing together local stakeholders sharing their interests, promoting or presenting the project and the STEAM lab, raising interest and recruiting participants.
STEAM Endurance	Testing the endurance of the methodology focused on certain thematic areas.
STEAM Ateliers	Each lab creates various local events. This includes testing and creating educational activities, but also enabling stakeholders to strengthen their involvement and allowing for deeper impact. Hereby, STEAM education shall be established as part of activities in the local contexts promoting a culture of co-creation in each lab, while incorporating findings in SENSE. and ensuring the longevity of STEAM.

Table 3: Local implementation strategy – 3 kinds of events

The report D4.1 specifies the preparations and actions taken to set up the STEAM Labs, especially describing the STEAM Lab launch events (cf. 2.2).

Forms of Implementation Activities
"Implementation Activities" are all activities taking place in the STEAM Labs. The activities of each STEAM Lab strongly depend on the local contexts and interests, the target groups, as well as other conditions such as budget, constraints, or experience. The core of implementing the methodology is the application, adjustment, development of SENSE. learning sequences – more precisely described in Chapter 5.1 of this report. Nevertheless, implementing SENSE. also involves workshops, presentations, trainings, discussions, publications, exhibitions etc., i.e. anything that contributes to the above-mentioned three fields the STEAM Labs address.

The variety of implementation activities was visualized and presented at the SENSE. project meeting in Tbilisi (October 2023) early in the implementation phase. This visualization does not represent hierarchies and should not be seen as a fixed model, but rather as an attempt to show how each activity in the STEAM Labs is part of the implementation.
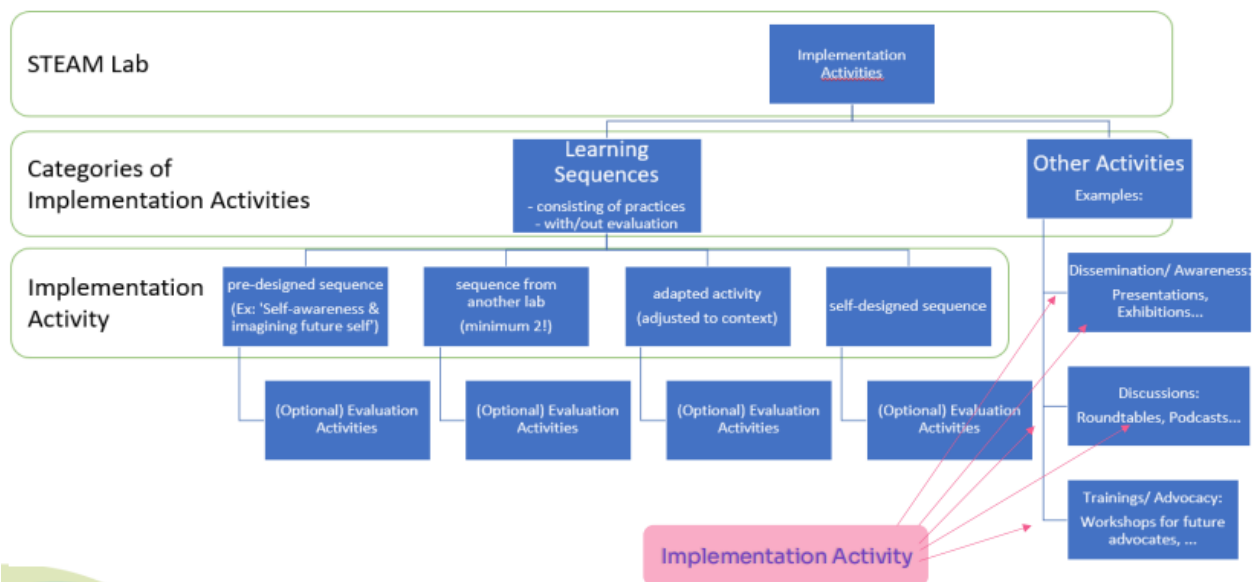
Figure 18: Visualization of Implementation Activities

Coordination Strategy

The coordinators of WP4 set up multiple mechanisms to guide, support, and monitor the implementation and evaluation of SENSE. across the STEAM Labs (cf. 4.2). This mainly served the goal to keep track of the actions and follow the progress on the KPIs (cf. 4.3.3). All STEAM Labs agreed to report each implementation activity via the tools WP4 developed, providing details about the activity, participants, and outcomes.

The STEAM Labs engaged external stakeholders in implementation activities tailored to their context, eventually offering at least ten documented activities for evaluation. Lab actions included testing and evaluating (parts of) learning sequences, training of early adopters and potential advocates, disseminating approaches and results or discussing needs and related topics. Reports to WP4 coordinators informed the development of conclusions feeding the corresponding reports and eventually the SENSE. Roadmap and its accompanying tools and resources.

4.2. Guidance in Implementation

4.2.1. Guidance and Reporting

The whole implementation phase was based on the results from the first year of the SENSE. project, eventually collated in the deliverables about the stakeholder analysis (D3.3), the knowledge and practices across the consortium (D3.4) and especially in the report formulating the SENSE. methodology (D3.5). For the successful strategic implementation of SENSE. across the STEAM Labs, the WP4 coordinators provided a multitude of supporting mechanisms. Some of these were already outlined in the "Report on the Launch of the STEAM Labs", including guidance and material for setting up the labs along with their launch events, suggestions for needs assessments, and the realisation of cluster meetings. For more information, head to Chapter 2.2 of this report.

The following instruments were developed to guide and support the implementation activities in the STEAM Labs:
- The supporting structures for preparing launch events (cf. 2.2)
- The WP4 General Meetings: This irregular series of meetings led by the WP4 coordination team was mandatory for all STEAM Labs. It served as the main place for distributing information about implementing, evaluating, and reporting and offered the possibility to discuss common or individual issues. In later stages these meetings were used to update all labs about the implementation so far to draw conclusions for future activities and discuss strategies to consolidate experiences, reflections and results.
- STEAM Labs sessions at the Tbilisi project meeting in October 2023: These sessions consisted of presentations and hands-on workshops on how to report different implementation activities, how to design prototypes of SENSE. sequences (more information below), how the co-evaluation works, and displayed the supporting offers and monitoring strategies that were set up.
- Sharing Labs: These voluntary weekly meetings aimed to foster engagement, share experiences or strategies, and collaboratively overcome challenges.

These instruments were complemented by the following documents:
- The guidance document for the co-evaluation (see report D4.3) across the STEAM Labs, explaining the methodology and requirements.
- The guidance document for reporting any activities the STEAM Labs implement. It highlights tasks and deadlines, explains the purpose of reporting and tracking activities and describes implementation activities focused on reporting. It is attached as Annex 1.

- A short presentation summarizing the required reports, the due dates we agreed on, and the upload structure for any material from the lab activities. It is attached as Annex 2.

In the initial phase, all STEAM Labs reported about their launch event along with a calendar of planned events (cf. 2.2) and the results of their local needs assessments (cf. 2.3).

The aim was to collect all potentially relevant different actions taking place in the STEAM Labs while harvesting all valuable information about any implementation activity, along with its rationale, participants, and outcomes. In later stages the reporting process had to also involve collecting data on the implementation and evaluation of strategies from WP5 (space) and WP6 (social inclusion & gender).

To achieve this, every implementation activity within the STEAM Labs was to be reported by the facilitators, supported by two inevitable tools:

- A thorough template designed to suit the reporting of any implementation activity. It is attached as Annex 3.
- A shared spreadsheet collecting all planned and executed implementation activities per lab along with data on the participants and external stakeholders involved. It served as the key monitoring tool for the WP4 coordinators, who used additional tabs to collate overall data and observe the process.

WP4 coordination member PHW committed to monitor the planned and reported activities as well as the KPI progress and suggest further actions such as mitigation or recommendations to the WP4 coordination team and eventually the STEAM Labs.

To offer a specific and well-informed reference person for any issue within the implementation phase (including launch, design, implementation, evaluation, or reporting) in the STEAM Labs, the WP4 coordinators assigned responsibilities across its members and shared these chosen counterparts with all partners.

4.2.2. Guidance on Designing SENSE. sequences

The overall general workflow of how SENSE. sequences can be designed was shared with all partners and lab representatives as part of the Tbilisi consortium meeting in the first week of October in 2023 and distributed as presentation afterwards. This step-by-step visualization (Fig. 19) demonstrates the different inputs and conditions that overall lead to a recursive process of adopted and shaped learning sequences that build on the SENSE. methodology and involve SENSE. evaluation.
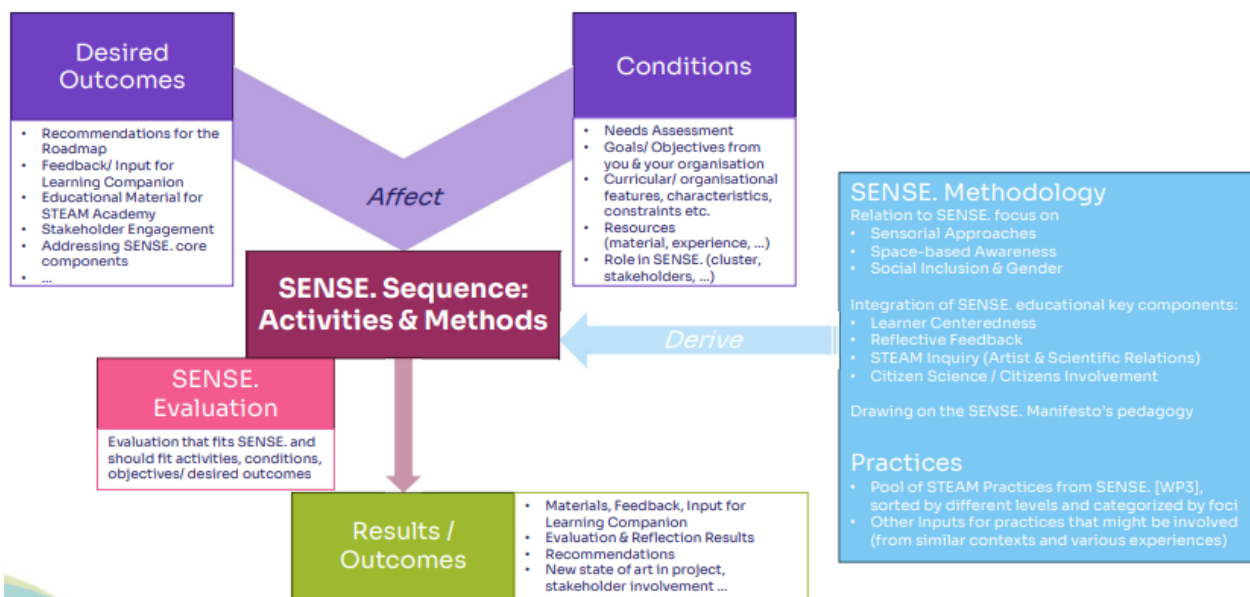
Figure 19: General workflow in designing SENSE. Sequences

The SENSE. methodology outlined in deliverable D3.5 acts as theoretical framework, stating to integrate the educational key components of learner centeredness, reflective feedback, STEAM inquiry, and citizen science/ citizens involvement. To involve these objectives along with focusing on sensorial approaches, space-based awareness, and social inclusion & gender, designers were advised to draw from the unique SENSE. pedagogy concretized in the manifesto (Fig. 15).

Further, it was suggested to derive practices as part of the learning sequence from the pool of (STEAM) practices collated ahead, while considering conditions from the institution's point of view (such as assessed needs, goals, constraints, resources) and the desired outcomes in view of the project, which include developing educational material and engaging external stakeholders while trying to obtain contributions for the roadmap and its learning companion. The SENSE. evaluation is considered an integral part of the SENSE. sequences and further outlined in deliverable D4.3. Finally, the workflow shows potential outcomes from implementing sequences that were designed based on the steps ahead – which then could lead to potential conclusions or modifications for future sequence design.

The whole workflow was displayed as a "current state of affairs", meaning that it was intentionally ascribed to be dynamic and indefinite. On one hand, there were versions before the one above and on the other hand, the whole process was in a way simplified during the implementation phase and particularly after the analysis of results and reflections, leading to a re-elaborated, more precise and functional procedure of designing SENSE. sequences, that embeds connections to tools and methodology. Read more about this in Chapter 5.1 of this report.

4.3. Overview of Implementation Activities

We recorded 244 implementation activities overall. As they were carried out in 12 different labs in 13 different countries this connotes an average of 18.8 per lab.

4.3.1. Activities

In this document we distinguish between the following different forms of implementation activities (see Chapter 4.1):

- "Learning Sequences": These include entire learning sequences or parts thereof, such as practices, workshops, notable icebreakers or methods, or similar teaching-learning situations that inherit the implementation of practices more or less aligned with SENSE. They were carried out with or without evaluation.
  See Chapter 5.1 for a more elaborate description of learning sequences.
- "Dissemination Actions & Discussions": These implementation activities were originally labelled as "Other Activities" in the visual distributed in Chapter 4.1 and contain any further forms of implementation, such as trainings, dissemination actions (launch events, publications of any form, speeches, exhibitions etc.) and discussions (needs assessments, panel discussions etc.).

On some occasions, a single event was composed of multiple implementation activities – especially the launch events often included dissemination actions, discussions, and parts of learning sequences. In these cases, we split the happenings in several activities to be able to analyse them separately.
These arrangements led to the following overall statistics on implemented activities:

Activities	Overall	Per Lab	Participants
Implementation Activities	244	18.8	112.764 (+)
Dissemination Actions & Discussions	99	7.6	109.528 (+)
Learning Sequences	145	11.2	3.236

Table 4: Overall implementation activities

4.3.2. Participants

The total number of participants refers to the sum of people counted as recipients of all activities, therefore not stating we involved that number of unique participants but rather that 244 activities were run with a total of at least 112.764 participants. As we don't have participant data for every event, and some events may have gone

unreported, the actual total of participants in all implementation activities combined must be slightly higher.

It is important to note that some of the participants in dissemination actions & discussions are viewers of (e.g. social media) posts or articles, meaning that we know they were reached, but not whether they actually read or viewed the corresponding dissemination activity.

Thus, when reporting on the SENSE. beneficiaries that were addressed by actions of the STEAM Labs, it is reasonable to focus on the 188 activities we have actual participant data on, while additionally excluding activities that only provide data about views, accounts reached, or potential readers (i.e. no newsletters, social media posts, articles, press releases etc.).

The table below shows the absolute numbers of the participants within these 188 implementation activities, along with the percentage of activities the beneficiaries participated in.

A: Students 13-18	B: Students 19-25	C: Girls	D: Parents	E: Employers & Businesses
1598 (37.1 %)	839 (20 %)	1622 (37.7 %)	35 (0.8%)	75 (1.7 %)

F: Schools, Teachers, Educators	G: Cultural & Artistic institutions	H: Academic Staff	I: Policy-makers/ decision-makers	J: General Public
425 (9.9 %)	118 (2.7 %)	268 (6.2 %)	63 (1.5 %)	225 (5.2 %)

Table 5: Participants in implementation activities

As depicted above (Tab. 5), the implementation mainly addressed students of both age groups (A and B), and – considering that they sometimes were not counted separately – approximately almost the half of the actions involved girls (C). Other beneficiaries were significantly less involved. The participants, i.e. beneficiaries, are further discussed in Chapter 5.2.

As the immense variety and heterogeneity of the people involved in the STEAM Lab implementation activities of any kind is an absolute highlight of this phase and the project overall, depicting this multiplicity solely with numbers doesn't do justice. Thus, it is recommended to delve into Chapter 2.3 of this report and watch the featured videos to catch a glimpse of what the different labs were able to experience.

4.4. Learning Sequences

Learning Sequences in the STEAM Labs
A sum of 145 individual events involved the implementation of (parts of) learning sequences with more than 3.000 participants in total. The design, adaptation, execution, and reflection of learning sequences essentially serves the (further) development of educational material and the generation of findings for SENSE. (learning) Sequences which is then elaborated in Chapter 5.1. The implementation of learning sequences or practices that may be part of them aligns with all three fields the SENSE. labs announced to address: The unique SENSE. methodology is progressively implemented, materials and actions are developed and resources for the final product, the roadmap and its digital hub, are produced.

The DoA (part A) states that "all labs develop educational sequences based on the results from WP3" and "all labs will pay attention to embed citizen science and art-science activities" (p. 9). While the SENSE. methodology, stakeholder analysis, and pool of practices, all compiled within WP3, served as the basis for implementing learning sequences of any kind (cf. 3.1), the actual individual implementation strategies were drawn under consideration of local features, as already mentioned in the description of the implementation strategy (Chapter 4.1).

Examining the workflow in designing SENSE. sequences
The workflow for planning learning sequences (Fig. 19), as described above in Chapter 4.2.2, combines general didactic considerations with elements that are specific to the STEAM approach in our project (for more details see section 5.1). The planning process considers the respective framework conditions, the goals to be achieved, as well as the methodological impulses related to the project. The implementation reports provide examples that illustrate the variety of perspectives leading to concrete implementations. For instance, the range of intended outcomes for the same practice ("Article from the Future") varies from strengthening participants' connection to their local environment (WECF, 9.12.23), enabling participation in a cultural activity for youth in a structurally disadvantaged setting (GEYC, 19.2.24), to a playful exploration of SENSE. methods for prospective teachers (PHW, 9.5.24).

Accordingly, the impacts of the SENSE. methodology were weighted differently. For WECF, the focus was on deepening and strengthening awareness of the substantive aspects related to the development of the living environment. GEYC emphasized the value of the fact that all participants were able to actively contribute to the process during the practice. For the prospective teachers at PHW, breaking away from traditional scientific work patterns in favour of a creative process was particularly important.

The perspectives on the needs assessment were equally diverse. In the WECF activity, it was conducted together with the participants and focused on the substantive areas they wanted to address. For the GEYC activity, the priority was to offer an attractive program within the framework of youth work in a disadvantaged rural environment, with little emphasis on content. In the activity for the PHW students, the interest arose from the desire to learn about the SENSE. methodology itself to apply it meaningfully in their future teaching practice. Overall, the design process envisioned in WP3 proved as a robust and versatile tool for planning and implementing SENSE. activities under extremely diverse conditions and with an equally large diversity with respect both to the participants and the facilitators.

Sorting Learning Sequences
For the collation herein we set apart practices as singular distinguishable activities that align with the art-science integration, parts of the SENSE. pedagogy, or origin from citizen science interventions, from learning sequences that seem to address a bigger topic with larger considerations around and may consist of a variety of practices. It must be very clear that this differentiation is imprecise and mainly serves the goal to summarize (and label) series of activities with high similarities. The clarification of terms advanced during the implementation phase and is explicitly described in Chapter 5.1.

The STEAM Labs carried out 13 different activities we assigned to learning sequences in a total of 98 implementations, and 17 different activities we assigned to practices in a total of 63 implementations. This sums up to a total of 161 implementations of (parts of) learning sequences within the 145 implementation activities.
Some of the learning sequences were carried out across two different implementation activities that were counted in the overall number but collated into one implementation herein. Also, some implementation activities consisted of a combination of practices, some of which were associated with more than one learning sequence or practice.

Implementations per Sequence & per Practice
The table below (Tab. 6) shows the implementations per learning sequence along with the STEAM Labs (partners) that executed activities we assigned to this sequence.

Label	n	Partners
Shadow and Light	14	HB, Louvre, WECF
Heat Chronicles	11	UB
Mapping Activities	11	GEYC, HB, HVL, ODY, PHW, UB, UEdin, WECF
Citizen Science Minis	10	GEYC, PHW, UEdin, UB
STEAM Garden	9	UEdin
Making Together – Open	8	PHW, UEdin, Velvet
Taxonomy Order of Things	8	HVL, UEdin, WECF

Invisible – Sensorial Awareness	7	CREDA, PHW, UEdin
Botanical Prints	6	Louvre, PHW, UEdin
Photovoice	6	CREDA
Approaching Colours	3	PHW
Envisioning Future	3	CREDA, HVL, ODY
Environmental Content	2	CREDA
Sequences: 13	98	

Table 6: Implementations per Sequence

This table (Tab. 7) shows the same for the practices.

Label	n	Partners
Extraterrestrial Life	14	HVL, VilVite
Article from the Future	8	Creda, GEYC, HB, HVL, PHW, WECF
Gender Portraits	8	GEYC, ODY
Portraits	8	CREDA, HVL, ODY, UEdin, WECF
House for the Fairy	6	GEYC, HVL, WECF
Gender Roles	4	GEYC, WECF
DINE	3	GEYC, ODY
Drawing Sounds	3	PHW, WECF
Art of Measuring	1	SP
Building Bridges	1	WECF
Falling Leaves	1	HVL
Hands-on Optics	1	PHW
Human Bingo	1	ODY
Matter of State	1	WECF
Photographic Explorations	1	PHW
Reclaiming our Bodies	1	GEYC
Skin of the World	1	GEYC
Practices: 17	63	

Table 7: Implementations per Practice

Process of Implementing Learning Activities
The graph below depicts the number of implemented (parts of) learning sequences across the implementation activities per month in the STEAM Labs.
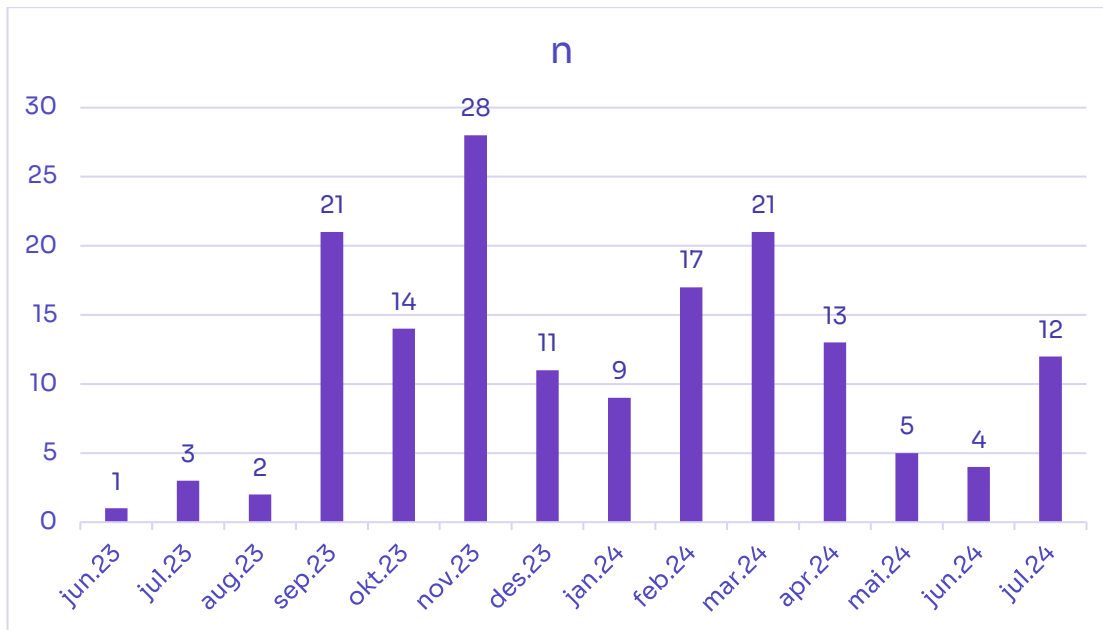
Figure 20: Implemented Learning Sequences & Practices per month

A lot of activities happened in September 2023, partly within the launch events, and the execution of learning sequences peaked in November. Due to the holidays, the numbers dropped in December and January only to rise again in the spring.

Origin of the Activities

As many of the activities were based on previous work, especially from WP3, we also compiled the origin of each of the implemented (parts of) learning sequences. We distinguished between three types of origins:

- Pre-designed = These activities were designed in or beneath WP3 and applied in a way extremely similar to their original design. This more often applies to practices (such as "Article from the Future").
- Adapted = These activities originated from WP3 or other project activities but were remarkably adapted to local or contextual singularities.
- Own = These activities were designed (or adopted from elsewhere) without a particular relation to the project's earlier activities.

Origin	n
pre-designed	38
adapted	56
own design	63
unknown	4

Table 8: Origin of implemented (parts of) learning sequences

The DoA explicitly announced that every STEAM Lab will cross-test at least 2 activities from other labs in order to validate the methodology across different educational

contexts and thematic areas. As the combined amount of pre-designed and adapted activities is close to 100 and most of those implementations correspond to the cross-testing (sequence/ practice most likely came from another partner and was tested there as well), the cross-testing was ultimately achieved beyond expectations. This is also visible in the tables further above (Tab. 6 & 7) showing the executing partners of the activities.

Learning Sequences to highlight
Some of the sequences or practices seem particularly promising or interesting for different reasons:

Implementation Activity	Comment
Shadow and Light [Sequence]	This collection of similar activities was carried out in a maximum value of 14 different occasions across three different labs. The exact design was highly varied, while all actions were grounded on the same 2-3 original practices (Bodyclock Architecture & Shadow Hunting).
Mapping Activities [Sequence]	These diverse activities all involved individual sensorial perceptions in the assessing and mapping of a particular space – and were carried out in different forms by eight(!) of our STEAM Labs!
Mini Citizen Science [Sequence]	As the Description of Action (A) explicitly stated that "all labs will pay attention to embed citizen science" (p. 9), these various actions all follow similar approaches of involving a community around.
Article from the Future [Practice]	This practice was applied across a bandwidth of contexts with eight implementations in six different labs, while remaining almost unchanged and being only slightly adapted.
House for the Fairy [Practice]	This activity fits many components within the SENSE. methodology, as a lot of manifesto elements are addressed within this sense-driven, highly inclusive and empathic, space related activity that even offers potential to link to future-making and sustainability.

Table 9: Outstanding Learning Sequences

Partners
The partners followed different implementation strategies as they had to adopt their local contexts and conditions as well as organizational goals, while respecting their individual target groups. For example, the STEAM Lab at VilVite co-designed a practice called "Extraterrestrial Life" together with HVL and integrated it in their courses to repeatedly implement it with their main target group (students). Other partners designed series of whole courses, such as the "STEAM garden" sessions at

UEdin, the "Heat Chronicles" at UB, or the "In*Visible" series at CREDA, to progressively create series of related or identic practices, where the beneficiaries were actively involved in co-designing further process. The third strategy we could observe was partners applying a broad variety of (parts of) learning sequences in their existing contexts, tailored to the needs they assessed amongst the participants and external stakeholders they typically involved. This approach could exemplary be assigned to the STEAM Labs at GEYC or WECF.

The table below shows the overall number of (parts of) learning sequences each partner applied, and how many different sequences were used in the implementation.

Partner	n	different
CREDA	14	6
GEYC	13	9
HB	15	3
HVL	19	8
Louvre	6	2
ODY	14	6
PHW	17	10
UB	15	3
UEdin	19	8
Velvet	5	1
VilVite	11	1
WECF	12	10
FUNDUS (SP)	1	1

Table 10: Numbers of implemented (parts of) learning sequences and of different sequences or practices applied

The numbers of participants and therefore the beneficiaries reached in those actions widely differ as well, as already indicated in Chapter 4.3. Further results and reflections about the participants can be found in Chapter 5.2.

4.5. Dissemination Actions & Discussions

STEAM Labs serve as the backbone of most dissemination actions, and the implementation of dissemination actions & discussions needed consonance with the revised DECP (deliverable D2.2). Herein, we attempt to firmly treat the relevant actions in and about the STEAM Labs.

Overall, we counted a total number of 99 actions we would assign to the category "Dissemination Actions and Discussions", as shown in Chapter 4.3.
Although we tried to consider every notable action, not every action was reported explicitly. More information about the dissemination, communication, and

exploitation within the project and amongst the STEAM Labs can be found in the various reports WP2 consolidated.

The graph below depicts the number of implemented dissemination actions and discussions per month across the STEAM Labs.
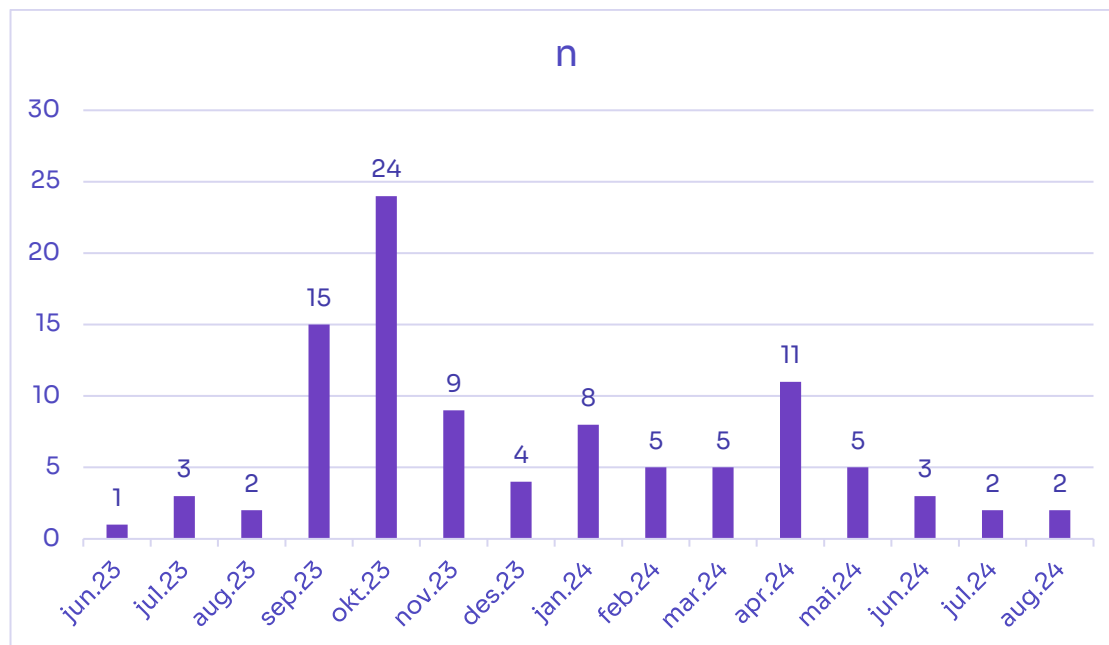
Figure 21: Dissemination Actions & Discussions unambiguously assigned to certain STEAM Labs per month of the implementation phase

The launch events taking place in September and October 2023 along with accompanying actions caused a peak in the implementation of such actions early on.

Variety of Activities
Due to the nature of the actions, that consist of publications, presentations, outreach events of any kind, discussions with stakeholders, posts on various channels, etc., it is impossible to make clear statements about the number of people reached. Often it is not only challenging to count "participants" of these actions, but rather absurd – which applies especially to accounts reached via social media posts. Thus, the numbers we were able to collate can only be considered an orientation for the dimension of people that actually attended dissemination actions within and around the lab activities.
The number of people that were reached by events (participants, audience, listeners, readers, representatives of institutions, etc.) and that we could disseminate parts of our actions or methodology to, is most likely somewhere near 100.000. As these implementations often happened within established institutional contexts, these cannot be considered unique people – but rather a total amount of participants addressed or reached by dissemination actions and discussions of any kind within the STEAM Lab implementation activities.

Dissemination activities are a pre-requisite for sustainability and endurance. Different stakeholders that are potential (early) adopters of the roadmap are informed and attracted. Teachers and other institutions practicing STE(A)M have been a major target of information activities. Policy makers have been involved from the start to ensure their support for the roadmap and the future of science education. This said, the external stakeholders that were explicitly addressed in discussions and some of the dissemination actions are not to be considered only as passive recipients of information, but rather as actively involved in the implementation of our methodology – as collocutors or partners, adopters or advocates, critics or advisors.

Communication about the Lab activities
Communication takes place through a variety of channels, that are shortly depicted below. For more elaborate information about communication and dissemination within the SENSE. project we would like to once again refer to WP2 and its corresponding reports.

The main means of communication on the Lab activities is social media, where all STEAM Labs were introduced and promoted with pictures, text and video materials. In addition, the implementation activities in the STEAM Labs that are driven by civil society organizations, i.e. ODY, GEYC, WECF, were being showcased on social media of the partner channels. The SENSE website inherits a special section that displays information on lab activities. In-depth articles about a selection of practices and issues have been published quite regularly. Some presentations serving as info packages have been distributed on the website as well, albeit they not directly relate to a particular lab but rather are part of a common effort to ensure the endurance of the implementation process.

Besides social media and the website, partners communicated about the STEAM Lab activities via posters, local media, email invitations and letters.

In the beginning of the project a press release was shared among major media outlets. At the beginning of 2023 a newsletter was published and distributed among a bandwidth of stakeholders from the different institutions. Additionally, partners engage in different promotional events, festivals, and fairs to spread information about their lab activities.

4.6. Cross-cutting Issues in Implementation

The consortium partner Hawkins\Brown (HB) acting as the lead of work package 5 "Cross-cutting issue: Space" developed a spatial awareness kit (see D5.1) which acknowledges the contextual nature of space and works as a guide for a structured and informed reflection on the impact on the physical environment. This kit was integrated into the reporting template (cf. 4.2) for the STEAM Lab facilitators to reflect on space before and after carrying out (learning) activities. Additionally, Hawkins\Brown conducted interviews and work sessions with the STEAM Labs and focused on the role of space in their own lab's actions. The outcomes of this process of evaluating space strategies are reported in deliverable D5.2. It also outlines different spatial typologies and explains the two overarching categories of "supportive" and "explorative" spaces. The forthcoming report after (D5.3) builds on the insights and presents a simplified "spatial self-experimentation kit" along with design principles for STEAM spaces.

The other cross-cutting issue "Social Inclusion" was also integrated into the STEAM Labs' implementation via inputs from the lead of the corresponding work package 6, University of Barcelona (UB), and reflection forms within the implementation activity reporting template (Chapter 4.2). The impetuses integrated in the post activity reflection from facilitators are based on the scoping report on social inclusion and gender in STEAM (D6.1), while the evaluation of the social inclusion strategies is described in D6.2 along with its outcomes. Similar to WP5, the deliverable thereafter presents a social creativity toolkit (D6.3, in progress).

Citizen Science strategies and activities played a special role in the implementation phase. The STEAM Lab at UB focused on citizen science activities in a larger scale, which they already were experienced in, providing indispensable results as well as guidance for the other labs. On a smaller scale, all STEAM Labs were encouraged to try out citizen science activities ahead of the project meeting in Bucharest – as all labs were required by the DoA (part A) (p.9) to include citizen science and participatory art-and-science activities in their implementation. Some different quick citizen science actions were proposed by Sibylle Peters from the Theatre of Research and adopted by some of the STEAM Labs.

5. Reflections on SENSE.

This section outlines the lessons learned from implementing SENSE. across the STEAM Labs, focusing on activities and participants. The first chapter is about understanding, designing, and implementing SENSE. learning sequences. Chapter 5.2 is dedicated to the participants in the lab events, elaborating their participation and reactions to then draw conclusions on whom SENSE. is for. The third subsection offers a closer look at the lessons learned from activities.

5.1. SENSE. Learning Sequences

Terminology and Methodology

First, a few clarifications of terms: In the context of the SENSE. project, an *activity* refers to any type of (educational, social, research, …) event, intervention, exchange, etc. within the framework of the STEAM Labs. A *learning sequence* refers to an activity of a STEAM Lab that focuses on communicating, teaching, or researching a topic or issue (in whatever form). In the context of such a learning sequence, characteristic *practices* are used – the development, testing and documentation of such are important goals of the project. SENSE. STEAM practices involve, activate, or inform participants and can be content-centred, teacher-centred or equally focus on social interaction or refer to open learning environments.

Learning sequences within the framework of SENSE. are in line with the four pillars of the SENSE. educational model (cf. Fig. 14 in Chapter 3.1). Accordingly, they should be organized in a learner-centred manner and include reflective feedback. Furthermore, they can be assigned to one of the fundamental areas of SENSE., i.e. sensual or artistic inquiry, spatial exploration or design, inclusive collaboration, citizen science, or art practicing - or at least contain elements of these. Other potentially important elements are social inclusion and conscious involvement and handling of sensory experiences using appropriate practices. The methodology for the evaluation of practices and activities takes these special features into account through careful data handling (cf. 3.2), multimodal assessment, cross-testing, and co-evaluation (cf. report D4.3).

The Didactical Framework of SENSE.STEAM

On the base of the four pillars of the SENSE. methodology (see Chapter 3.1), the SENSE. project agreed on a set of key objectives for the design of learning sequences. The first pillar is Learner Centeredness: SENSE. adheres to learner centred rather than authority centred approaches, shifting from seeing learners as knowledge receivers to active creators of their own learning, promoting self-directed learning and

empathy (cf. DoA (part B), p,11). SENSE. is not limited to traditional learning environments but also addresses Citizen Science (CS) and Art practices. The art-based CS approach will facilitate engagement with scientists and artists, science labs and art places or the local environment, to explore discuss and reflect together on matters important for community. (ibid., p. 11).

Another central objective is the realisation of STEAM Inquiry: This term points to an integrated inquiry approach incorporating methods from STEM and artistic-aesthetic education, creating a transdisciplinary and adaptable starting point for STEAM education. This approach can be related to national curricula, provides the methodological background for a learning continuum, and is responsive to societal and business needs. In particular, the SENSE.STEAM inquiry is built on 9 capacities (cf. Lincoln Center Institute's capacities of imaginative learning, pp 2-3):
- Noticing deeply
- Embodying
- Questioning
- Identifying Patterns
- Making Connections
- Exhibiting Empathy
- Living with Ambiguity
- Creating Meaning
- Acting, Reflecting, Assessing

Based on these capacities, a series of didactical elements were developed. These elements represent potential concretizations of the methodological approach and serve as design factors in the development and/or implementation of activities. As already mentioned above, they were first collected in the project Manifesto (Fig. 15 and 22, resp.). Figure 20 provides an overview of these elements:

SENSE!	INVOLVE!	MAKE!	IMAGINE!	RELATE &CONNECT!
Encourage an open disposition to observe by engaging all the senses: *What colours? What textures? What smells? What sounds can I/we perceive?* Provide opportunities for perceiving, describing and sharing: *What is happening? What do others perceive on the whole sensory spectrum?*	Recognize backgrounds and lived experiences of all. Offer different spaces for contributions with different degrees of involvement and spend time to share them to make the activity more valuable to everyone. *What do I/you bring to this experience? What does this mean to me? And to you?*	Introduce opportunities to observe and share experiences through creative manipulation and hands-on processes: *What does it show? How does it change? What does it do?*	Come together to engage multiple logics and different ways of thinking: *What is this for you? How does this work? How could this work? How did others feel about it? How can I change the space to create different ways of thinking and doing?*	Stimulate drawing connections: *How does this relate with … other things?' What new ideas/ opportunities arise?*

SET OFF TO FIND OUT!	DISCIPLINE SWITCH!	COPRODUCE &ACT	BE DIVERSE & INCLUSIVE!	WORK WITH SPACE, PLACE AND TIME
Introduce a stimulus for an open and open-ended situation to be explored: *What matters to me? What matters to us as a community? What do I already know about this? What would I like to know about it? What do I want to start with?*	Encourage the integration of scientific, artistic, aesthetic, spatial, technological, social 'languages' for making sense of facts, phenomena, challenges.	Bring together learning and knowledge with the capacity to act individually and collectively on matters of common concern. Co-produce scientific evidence in joint research and learning processes; and on joint research within the learning process.	All along the whole learning process, question yourself if you are leaving anyone aside. Revise language and activities to be inclusive. Avoid the exclusion of any collective or group. And favour the involvement of underserved groups and communities.	Situate and connect question and activities in space and connect with the local context. Pay attention to the political dimensions of the space

Figure 22: Elements of the SENSE. Manifesto

Didactical attitudes and educational intentions

Such elements reflect didactical attitudes that are essential to the project: learning sequences should be open and accessible to all participants (especially for people who are more disadvantaged in traditional formats), they should be based on concrete experiences and events, they should promote creative or collaborative processes and encourage interdisciplinary perspectives. SENSE.STEAM practices aim at implementing the methodological elements, serve as application of the SENSE.STEAM methodology, and include challenges that were formulated, for example, in connection with STEAM inquiry or address crosscutting issues such as space or inclusion. Activities (e.g. learning sequences) are to be designed using such practices. In order to achieve the goals related to the respective attitudes there is need for a appropriate design process.

These concepts shall be discussed using an example: The practice S*hadow Hunting.* This practice was originally developed by PHW for a seminar in which prospective teachers were to deal in depth with the topic of "light and shadow". At the beginning, the students were shown a presentation with examples of aesthetically pleasing, astonishing or otherwise interesting shadows and shadow phenomena. Then they were given the task of discovering examples of such phenomena on their own (or small groups) over a period of one week and documenting them with photos. Obviously, this incorporates both the methodological motives of learner centredness and inquiry. Also, the starting point is the aesthetic perspective, which has not yet been translated into the scientific questions of "why?" and "how?". In this sense, artistic practice also plays a constituent role. With respect to the capacities addressed by STEAM inquiry, motives as "making connections" or "identifying patterns" as well as "noticing deeply" or "creating meaning" are present.

The pictures show examples: The large candlestick on the first image (Fig. 23) appears highly distorted. Such an example can raise the questions of under which conditions the shadow represents a more or less lifelike outline of the shadow caster, or when distortions occur. On the second image (Fig. 24) you see a confusing but appealing pattern that is reminiscent of the shadow-casting leaves but has its own dynamic.

Figure 23: Candle's shadow

Figure 24: Leaves' shadow patterns

It is now interesting to see how this practice was applied and adapted within the project by another partner (HB). The activity did not consist of a seminar for science students, but rather the aim was to make creative and/or technical professions (e.g. to be an architect) attractive to school students. Here, the intentions are quite different from those above: light and the qualities associated with it are not viewed under the theme of "understanding", but as an essential (and tailorable) component of our architectural environment. The focus is not on the more or less systematic investigation of shadows, but on the active design of light-shadow situations.

This is where an important adaptation began: very soon the work assignment and the available material were expanded to include the aspect of colour and the organizers provided additional material, such as colour foils or materials that reflect light in interesting ways or create shadow plays. Activating the students through learner centredness was also an important intention, but not regarding investigation processes, but rather to creative and original design – and the problems that come with it: Create something without knowing why and how, having to set your agenda, journey and goal. In other words: The aim was to show that the journey is more important (or interesting) than the product. With respect to the SENSE. methodology, art practice is an obvious reference point. Again, the pictures show two examples:

Left (Fig. 25), a new space (made of light) in the ceiling opens up... Right (Fig. 26), two students have created their own setting serving as a lab for exploring possibilities of light design.
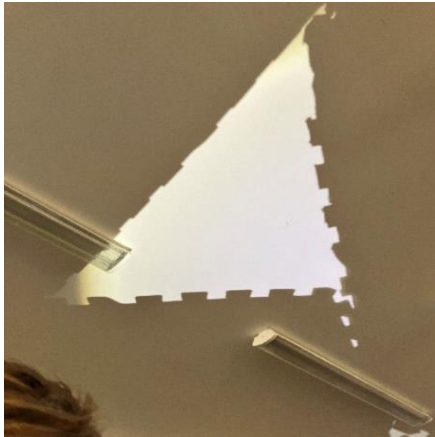
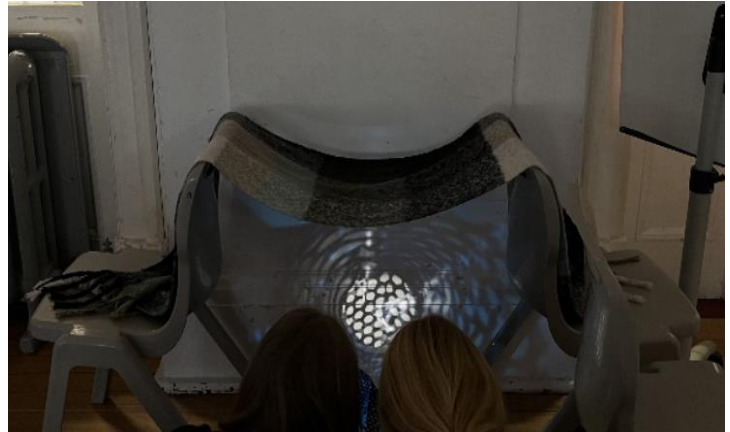Figure 25: Shadows create a space in the ceiling   Figure 26: Micro-environment by students

In the first example, the learning sequence would be the seminar and is organized as a learner centred artistic inquiry. Several *educational intentions* can be identified in relation to the seminar: from a scientific perspective, the individual examination of shadow phenomena serves to collect relevant observations that can serve as starting points for further research into the topic. With respect to the didactical framework capacities as "questioning", "creating meaning", or "identifying patterns" are possible reference points. Moreover, the investigation of shadow phenomena serves as an exemplary case of how scientific theory formation can work: based on observations, the key factors for the occurrence of the phenomena are identified and their connection is explicitly described. Activating the students is also an important point: the learners should deal with the content independently and with motivation. Furthermore, it was important not to treat the topic as a purely technical problem, but to give an example of the fact that we are surrounded by countless exciting phenomena or sensorial perceptions in everyday life and can often elucidate these on our own with curiosity and determined research.

For learning sequences organized by Hawkins\Brown the central objective was to transport the message "journey over destination", i.e. playfully experimenting with lights and objects without normative instructions or predefined outcomes. And again, the concretisation involved learner centred artistic inquiry but with different educational intentions focusing on experiences with designing and making with respect to aesthetic problems and the given environment. Here, the HB research team assumed that participants would actively explore their environment to find exciting reflection and shadow phenomena and did not pay too much attention to the provided light sources and materials. However, it turned out that the students were reluctant to engage in the unfamiliar format of activities without predefined learning outcomes. Furthermore, it quickly became apparent during the activities that brighter

light sources and materials that produce strong effects or colours have a much more stronger motivating effect. Within the activity, two different patterns of exploration were found: On one hand, students confined themselves to limited and shielded areas ("micro-environments") for an optimal control of conditions. On the other hand (and more rarely), students used expansive projections or large-scale colour effects to transform the entire room thus creating stunning effects within the "macro environment".

In both applications, other motives can be identified that can be representative or relevant for SENSE. activities: in both forms, the practices are largely open to inclusive aspects - students can deal with the work assignment according to their abilities and at their own pace. In both forms, the practice can be carried out not only in person, but also through digital media. And in both cases, it is essential that the respective learning groups perceive and appreciate the diversity of the individual contributions. And, of course, both versions strongly relate to *space* but in different manners: In the original seminar, spatial configurations appear as conditions for certain properties of shadows, and it is essential to understand these conditions. In the adapted seminar, space is a designable environment in which we intervene creatively and through technical means (cf. forthcoming report D6.3).

Enriching learning sequences with SENSE.
Regarding SENSE., it is clear that all these educational intentions have significant overlap with the objectives and principles of the project, e.g. both the motives of learner centredness and STEAM inquiry are present (see Chapter 3.1). Additionally, shadows have an intrinsic aesthetic appeal which should be appreciated. Against this background, the 10 characteristic SENSE. elements mentioned above (Fig. 22) can be integrated and the design of a *learning sequence can be enriched* by them. Note that in both learning sequences, reflective feedback played a crucial role for the development and adaption.

SENSE. elements then serve as goals that should be achieved with a concrete practice. In our example, there are obvious connections to the focus on direct sensory experience, the striving to produce (make) and share a portfolio of appealing pictures, working with space, place (situation) and time, triggering the desire to find out etc. Accordingly, this perspective assigns functions to certain practices: A design process for a SENSE. learning sequence would incorporate a SENSE. practise to achieve one or more of the listed goals that are characteristic for SENSE. and its approach to STEAM education.

From here it is also possible to show how SENSE. can be integrated into the planning of learning sequences in a general manner. A possible workflow would look like this:

- First, the (didactic) framework is defined: who is the target group for the learning sequence, what goals are aimed for, what framework conditions (space, time frame, resources...) must be considered etc.
- Secondly, an explicit needs assessment with respect to the target group is conducted: which elements or didactical attitudes from SENSE. seem useful for achieving the goals or for didactically enriching the learning environment? What SENSE. elements would participants benefit from?
- Thirdly, a decision is made regarding specific practices to be applied in the learning sequence. Such practices would have a concrete function with respect to added value in the quality of the learning sequence. The learning sequence is then planned specifically regarding time structure, interventions, work phases, materials, etc.
- Lastly, the learning sequence is reflected and, optionally, evaluated, both in terms of overall quality and in terms of the benefits SENSE. practices. The results should inform future planning and implementing of learning sequences.

Evaluating Practices, Activities, and Learning Sequences

The evaluation of practices strongly relies on co-evaluation and qualitative methods. Here, co-evaluation means that input is drawn not only from the participants but also the facilitators, organizers, and possible other parties concerned. In such an evaluation, it is not only relevant whether educational intentions and other goals are met but also how the activity or the practices applied change the condition and attitudes of the participants. Such evaluation processes aim at multi-perspective and versatile feedback.

Surveying the feedback from the project partners on their launch events and activities in the early phases of SENSE., it became clear that the main factor constraining the attitude of initiating, integrating, or adapting practices is (the lack of) didactical experience. The conclusion here was that the project output has to provide a sufficiently large number of examples in an appealing and approachable way. Furthermore, there should be a universal as possible strategy for designing learning processes including SENSE. practices. The concretized workflow mentioned above is intended to provide this.

For more on the evaluation methodology and results see report D4.3.

5.2. Participants: Stakeholders Reactions & Reconsidering STEAM Beneficiaries

SENSE. Beneficiaries in Implementation
This chapter is dedicated to a closer look at the SENSE. beneficiaries involved in the implementation activities. These were outlined in Chapter 3.1 (Table 1).
The analysis process is of a qualitative nature, collating information about the reactions, observations, and reflections from participants, facilitators, or observers of activities that enable us to make informed statements about the beneficiaries that were involved in the implementation phase. These statements only refer to the information collected and thus cannot be considered universally valid.

Out of the 244 implementation activities recorded (see Chapter 4.3), 188 of them include detailed data on the participants. These activities involved a sum of 4302 participants overall. The following Table 11 shows the numbers of involved SENSE. beneficiaries out of those 4302 participants in all those implementation activities, as well as the percentage of participants from each beneficiary group.

A Students 13-18		B Students 19-25		C Girls		D Parents		E Employers, Businesses	
1598	37.1%	839	20%	1622	37.7%	35	0.8%	75	1.7%
F Schools, Teachers, Educators		G Cultural & Artistic Institutions		H Academic Staff		I Policy-makers / Decision-makers		J General Public	
425	9.9&	118	2.7%	268	6.2%	63	1.5%	225	5.2%

Table 11: Beneficiaries in Implementation (absolute and percentage)

It is important to have in mind, that one participant can be assigned to more than one group of beneficiaries – meaning that the percentages are not supposed to sum up.

The following Table 12 shows the number of implementation activities each group of SENSE. beneficiaries were involved in. As some data was not collected, these numbers can be considered minimum numbers.

Beneficiary	A	B	C	D	E	F	G	H	I	J
Involved in __ activities	95	60	118	11	20	130	34	54	22	44

Table 12: Number of implementation activities that involved representatives of SENSE. beneficiaries

Stakeholders Reactions

The following tables (Tab. 13, 14, 15) depict the reactions and reflections of the various stakeholders, who were identified as potential beneficiaries of the new approach for STEAM education, in the implementation phase in the STEAM Labs.

Stakeholder	Students 13-18
How they should benefit from a new STEAM approach	They need to make decisions on their future studies.
Reactions in Implementation	This group reacted significantly positive to the implementation activities carried out. Although sometimes their engagement needed encouragement or reassurance as they seem not used to the openness of activity processes, they happily engaged and were proactive and creative. Especially when they feel heard and the content affects them (such as their surroundings or concerns), students tend to contribute extensively and playfully. When getting used to it, they enjoy the freedom of experimentation and exploration as well as sharing experiences and perspectives.
Stakeholder	Students 19-25
How they should benefit from a new STEAM approach	They need to decide about further study or choose a professional career.
Reactions in Implementation	The older students engaged enthusiastically in interactive exercises and specifically seemed to enjoy collaboration and communication. Group work, sharing experiences, prompting socialization and discussing common challenges seemed to delight them. Activities seemingly contributed to understanding each other while also fostering self-discovery and highlighting individual talents as well as the value of community.
Stakeholder	Girls
How they should benefit from a new STEAM approach	They need to overcome stereotypes and have better access to science-related studies and professions.
Reactions in Implementation	Many of the girls that participated in implementation activities were students, too – meaning, the statements above relate to them as well. Girls seemed inspired by the activities and reacted positively to creative activities as well as conversations or presentations. The actions carried out seem to foster a sense of ownership and have the potential to help developing new skills and collaboratively discussing and improving community.

Table 13: Reactions from students & girls (beneficiaries A, B, C)

Stakeholder	Parents
How they should benefit from a new STEAM approach	Parents are supporting the education and decision-making processes of their children at different stages.
Reactions in Implementation	Although there are not many reflections on parents, they responded positively to being involved. It seems parents enjoy actions that foster a sense of community and belonging while offering different ways to engage in potentially deep and partially emotionally driven discussions.
Stakeholder	**Employers & Businesses**
How they should benefit from a new STEAM approach	Employers are looking for work ready and creative students matching modern job profiles.
Reactions in Implementation	This group had some mixed reactions. Although a diverse participation and practical engagement appears useful to them, they were partially surprised by the activities and showed varying levels of satisfaction. The participants from this group seemingly wish for active participation and insightful collaborations.
Stakeholder	**Schools, Teachers, Educators**
How they should benefit from a new STEAM approach	Educators of any kind need hands-on pedagogical tools to implement STEAM and act as potential future advocates.
Reactions in Implementation	These SENSE. beneficiaries were definitely mostly satisfied with the implementation activities they participated in. They engaged heavily in activities, discussions and feedback, while also considering important conclusions from what they were part of, such as potential extensions of lecturing or the primacy of the process over the product. The teachers and educators even mentioned shifts in their own practise, highlighting the positive impact on participants while fostering creativity, engagement, and community. This group of beneficiaries is of utmost importance as they are potential advocates for STEAM and SENSE., making their positive responses inevitably pleasant.

Table 14: Reactions from parents, employers, teachers / educators (beneficiaries D, E, F)

Stakeholder	Cultural & Artistic Institutions
How they should benefit from a new STEAM approach	As these institutions relate science to society, they shall be enabled to act as meaningful learning spaces for productively integrating art and science.

Reactions in Implementation	The activities that focused on diverse participation, interaction, or art integration into learning or curricula were perceived well by representatives of cultural or artistic institutions. They reflected that time to feel comfortable is needed and group work should be further promoted.
Stakeholder	Academic Staff
How they should benefit from a new STEAM approach	The researchers are to promote and integrate STEAM inquiry and approaches in programmes and projects.
Reactions in Implementation	The researchers involved in implementation gave positive feedback on various actions. Their engagement seems to vary, indicating a possible instable interest in STEAM. While some reported they found new perspectives on incorporating interdisciplinary learning, others perceived community involvement, inclusivity, and awareness of career options as highlights.
Stakeholder	Policymakers / Decision-makers
How they should benefit from a new STEAM approach	As important partners they are to embed STEAM throughout the learning continuum in policies and curricula.
Reactions in Implementation	These representatives appreciated the diversity of stakeholders that enriched discussions and caused varied perspectives, leading to finding solutions to improve community & communication. The policymakers /decision-makers liked being introduced to interdisciplinary concepts and seemed to get valuable insights from professional development sessions or citizen science activities.
Stakeholder	General Public
How they should benefit from a new STEAM approach	The goal is a scientific literate citizenry, that believes in collaboratively facing challenges and adopt lifelong learning.
Reactions in Implementation	The participants involved showed an appreciation and deeper understanding of their surroundings and seemed to benefit from practical interaction with science or artistic approaches, leading to surprise and understanding. They highlighted safe spaces for new ways of thinking as well as sharing and valuing different perspectives and were specifically proactive when emotionally attached to issues or discussions. Young people and families displayed more energy and were easier to enthuse with activities.

Table 15: Reactions from representatives of other stakeholders (beneficiaries G, H, I, J)

Reconsidering Beneficiaries

The reactions and reflections from the different participants in the implementation activities lead to possible reconsiderations of the stakeholders who are supposed to profit from the new approach and methodology to STEAM education.

Both age groups of students showed positive reactions (Tab. 13), as well as the teachers and educators (Tab. 14), who are inevitably going to be further involved as advocates and adopters of the methodology. The engagement of cultural and artistic institutions (Tab. 15) turned out promising but there still seems to be potential for further involvement. The same applies to representatives of academic staff (Tab. 15). It is hard to assess the reactions from the beneficiary group "girls", as they always were part of another group of beneficiaries (mostly students), but so far, the implementation activities seemed to cause positive reactions without exceptions.

The representatives of the 'employers and businesses' category were partly not satisfied with their participation (Tab. 14) and indicated that the implementation activities in which they are involved should possibly be better tailored to their expectations or that these expectations should be be met by prior information measures.

The importance of policymakers and decision-makers in implementing STEAM is undeniable, as they can shape curricula and help create environments and conditions that suit the approach as well as take responsibility for resources and partnerships. The implementation activities in the STEAM Labs did not harvest enough data on their reactions (Tab. 15), although there were positive hints, further investigation is needed.

The stakeholders 'parents' (Tab. 14) and 'general public' (Tab. 15) were only slightly assessed and could be reconsidered or reformulated. Parents seem to be more indirectly addressed by actions their children experience rather than participating themselves. The public is difficult to study, as any unanticipated or spontaneous participant could be considered part of this group – while any member of the general public could potentially be assigned to other beneficiaries. The dissemination activities that could not be considered in participant figures, such as social media posts, newsletters, articles or press releases, etc., did indeed address the public without being visible in the participant data.

Lastly, the intense and promising involvement of children, i.e. younger students below the age of 13, and of civil society organisations conclude in discussions about their potential role as SENSE. beneficiaries.

5.3. Activities: Lessons Learned from Labs

Amongst other methods, analysis of SENSE. Activities relies on a standardised report format (cf. 4.2; Annex 3). There, the basic information from a report on a SENSE. activity covers:

- a description of the activity itself,
- information with respect to the authorship,
- The integration of the pillars of the SENSE. methodology
- references to the SENSE. Manifesto and the needs assessment,
- reflections from the facilitators.

For an overview of the main motives within the feedback we focus on two of the widest used interventions: the practices *House for the Fairy* and *Article from the Future*. The first practice was established by the project partner Hawkins\Brown, the latter by GEYC. Both practices were implemented in a range of educational environments ranging from academic institutions to more informal settings (Creda, GEYC, HB, HVL, PHW, WECF).

A large portion of the activities involved students as participants. Another important group consisted of student teachers or professional educators, in line with the nature of the institutions involved in the project. In addition, there are also implementation examples without a specific target group, particularly during the launch events. While these statements are likely to be generalizable within the scope of the project, the examples discussed here often emphasize the specific (and successful) support for girls.

The practice *House for the Fairy* asks participants to build a house for an imaginary fairy in a location of their own choice. This process engages participants in the design process (choice of location, resources, building a house that is robust, durable, and feasible etc.) and in reflecting on issues of scale and the correlations that exist between size, resources and effort/energy required. Furthermore, it demands consequential thinking as well as empathetic and imaginative skills, as participants take the perspective of a fairy, a smaller being for whom they adopt a responsibility. If materials from the respective location are used, the resulting house will also reflect some of the qualities and atmosphere of this environment.

While *House of the Fairy* invites participants to produce a material result, the practice *Article from the Future* asks them to imagine their community five years from now and think of what would be presented in a newspaper article. Concretely, they had to design a newspaper front page considering what kind of news, pictures, quotes, captions would go within the article. To do so, participants have to identify key topics and issues – and to project the current state into the future. Naturally, both positive

visions and concerns will contribute to the selection and shaping of topics. In this way, participants are encouraged to reflect and articulate their individual and collective needs and get engaged in a negotiation process for priorities.

The two practices effortlessly cover virtually all SENSE elements from the manifesto (Fig. 22): In addition to the more visibly prominent themes like "Make!", "Imagine!", "Work with Space, Place, and Time!" or "Coproduce and Act!", other themes such as "Sense!", "Involve!", "Discipline Switch!" and "Be Diverse and Inclusive!" are also directly evident in the reports.

Furthermore, both practices show a strong integration of SENSE. methodology, e.g. the motives of learner centredness or the use of reflective feedback as well as creative action and active involvement towards social issues and perspectives.

The activities in which these practices were applied vary considerably in nature and objectives. The spectrum ranges from the aim of professional development for teachers, to providing opportunities for open and creative group work among students, to settings where serious design processes within a community are to be encouraged. In all these examples the inclusive potential of the activities was emphasized. Additionally, feedback can be found almost everywhere indicating that, regardless of group sizes or external circumstances, the participants collaborated intensively, successfully, and persistently.

In the context of the activities, the practices were successfully implemented both directly according to the descriptions and in an adapted form. Such adaptations involved either the tasks (mostly with the aim of better engaging the respective learning group) or materials and circumstances. There are documented cases where the practice *Article for the Future*, typically held indoors, had to be conducted outside, and conversely, the typically outdoor practice *House for the Fairy* was moved indoors due to bad weather. In both cases, these changes proved to be manageable and also productive or interesting: in the first case, it became evident that the topics addressed by the group were more concrete and relatable than those of the parallel groups in the school building. In the second case, a laser cutter was used to create suitable components for the fairy house, thus adding an extra dimension to creativity. In conclusion, it seems safe to say that the SENSE. practices provide a very versatile and rather robust set of methods for enriching learning environments.

The documented examples of activities in which these practices were used allow for several further conclusions that should also be generalizable within the scope of the project. Generally, the overall acceptance of the practices among participants is very high. In some cases, activities were conducted by individuals who had no prior experience with the practice or STEAM education, nor were they familiar with the learning or target group. Even in such cases, the activity could be carried out without

major issues. A number of other unfavourable circumstances, such as unforeseen room changes, staff discontinuity, or technical problems, also did not pose significant obstacles to the successful implementation. Within the sample discussed here, the scale of the activities ranged from small groups to fairly large groups of participants.

Overall, the activities took place successfully within a very wide range of spatial and temporal conditions, participants, organizers, and settings. Both the active engagement with space and the inclusion of girls and women, as well as collaboration in creative and collaborative processes, are characteristics that can be clearly evidenced in the examples discussed here. While direct and sensory connections to the world, as well as interdisciplinary perspectives, are consistently important, themes such as digitization or scientific inquiry in the narrower sense appear to be less prominent. However, there were several dedicated activities – taken together under the title "The Order of Things"" aiming at the latter field. Another example would be the practice "Shadow Hunting" from Chapter 5.1. Generally, the activities employed proved to be versatile educational tools and very suitable for addressing the central concerns of the project.

6. Implementing SENSE. – Results and Conclusions

In summary, it can be stated that the implementation of the activities carefully and successfully ensured that both the methodology established in the first project phase and the underlying principles outlined in the DoA (part B) were implemented in the specific practices (cf. Chapters 3.1 and 5.1). The starting point were, on the one hand, the four pillars (learner-centeredness, citizen science and art practices, as well as reflective feedback, cf. 3.1 and Fig. 14) of the SENSE. philosophy, and on the other hand, their concretization into methodological elements within specific practices (SENSE.MANIFESTO, cf. 5.1 and Fig. 22).

For establishing frameworks to implement STEAM education with a high probability of success, certain actions (launch, local needs assessment, dissemination actions) are recommended, along with the advice to stay flexible regarding any situations and to benefit from collaborations. The assessed needs (cf. 3.3) describe possible assistance for designing and implementing in detail.

The documentation of implemented activities via a standardized reporting structure (cf. 4.2) made it possible to collect a range of key metrics. In this way, it is possible not only to illustrate how the implementation successfully performs in terms of KPIs (cf,

4.3.3), but also to document the impressive extent and wide range of the roughly 250 activities carried out by the project partners (cf. 4.3). Of particular importance in the implementation, alongside dissemination activities and discussions, were primarily learning sequences. These represent the actual application case for the SENSE. methodology. For the preparation of the implementation, the project developed a universal planning structure for learning sequences, in which SENSE. practices are to be integrated (Fig. 19, Chapter 4.2.2). Experiences from the implementation led to a simplified version (cf. Chapter 5.1) which will be part of the digital output of the project.

The impact of practices on participants can only be partially captured in the reports. This question is addressed in Deliverable 4.3. However, within the scope of this report, it can still be observed that the composition of the more than 4.300 participants (cf. 5.2) and facilitators was highly diverse. The overall acceptance of the practices among participants was very high, even when activities were led by individuals without prior experience in the specific practice, STEAM education, or the target group. Nevertheless, the original formulation of the SENSE. beneficiaries by the DoA (part B) might be discussed in the future based on the insights gathered from the analysis. Despite occasional challenges—such as unexpected room changes, staff turnover, or technical issues—activities were implemented successfully across various settings and group sizes. The examples highlighted showcase active engagement with space, the inclusion of girls and women, and collaborative creative processes. While direct sensory connections and interdisciplinary perspectives were consistently emphasized, themes like digitization and scientific inquiry appeared less frequently, though they were addressed in targeted activities such as "The Order of Things" and "Shadow Hunting" (Chapter 5.1). Overall, the practices demonstrated versatility and effectively supported the project's core objectives. A more detailed analysis based on key metrics and feedback from the reports can be found in sections 4.3 and 5.2.

The success of the implementation phase confirms the potential of the SENSE. methodology, and the initial results generated will allow to further improve future processes towards the final product.

7. Annexes

Annex 1: Guidance Document for Reporting Implementation Activities

SENSE. STEAM Labs – Guidance: Reporting Implementation Activities

Tasks & Deadlines (*for now!*)

When?	What?	Who?
ongoing	Update Table on planned activities [LINK](#)	PHW & STEAM Labs
ongoing	Report implementation activities via template [LINK](#)	All STEAM Labs
30.11.23	Report on Launch Event finished & uploaded	All STEAM Labs
31.12.23	Compiled calendar of planned activities (each Lab) ([Template](#) from D4.1)	All STEAM Labs
15.01.24	First Co-Evaluation sent to WP4 (50% data collected, see [Co-Evaluation Guidance](#))	WP4 Coordination All STEAM Labs
31.03.24	Minimum required co-evaluation collected (*KPI 2.3*)	WP4 Coordination
31.05.24	Implementation Activities collected (most of them) Minimum number of stakeholders involved (*KPI 2.2*)	WP4 Coordination
26.07.24	D4.2 (Implementation report) out to review	PHW & all
23.08.24	D4.3 (Evaluation report) out to review D4.4 (Recommendations for Roadmap) sic!	HVL & all
31.10.24	Submission of D4.2 & D4.3 & D4.4	Coordinator

Purpose of the document

This document gives direct easy guidance on how to report your implementation activities. The general need for reporting with its steps and features has been presented in the fourth WP4 meeting. The presentation can be found [here](#).
We need to track the lab activities mainly for 3 reasons:

- To monitor various implementation activities in general and provide support
- To track the progress on the KPIs 2.2 (numbers of stakeholders) and 2.3 (number of evaluated activities)

- To enable WP4 coordination team to report on the entirety of implementation activities within the STEAM Labs for the deliverable D4.2 [PHW, Oct. 2024]

==CARE==: This is about the general reporting structure for all lab activities and the template for reporting them, and not about the evaluation (own standards & guide).

==CARE==: We probably will adjust the reporting templates and guides, so envision this as a dynamic document serving as starting point for activity report collection.

Implementation Activities

Implementation activities in this context refers to every kind of action happening in the STEAM Labs that implements SENSE. According to WP4s tasks, we intent to develop educational material (Task 4.2), collect and evaluate data (Task 4.3), and gather recommendations for the roadmap and its learning companion (Task 4.4).

Find some collated general information about WP4 and the intention of the STEAM Labs (mainly collected from the Description of the Action) in Part A of the document "Lab Activities and Reporting Structure" right here (*currently a draft version*).

Example Activities

Depending on the different local contexts specific needs (remember the Needs Assessment?) result in a variety of social, cultural, geographical, economic, and organisation circumstances – reasoning in the fact we as WP4 coordinators can neither foresee your local focuses nor the certain activities your STEAM Lab will do.

Here is a list of some implementation activities – of course many of them will be adjusted to your needs, participants, contexts – and further activities might appear:

- Conduction of SENSE. learning sequences with/ without evaluation in various contexts (workshops, regular lectures, online, …)
- Presentations of SENSE. project or certain outcomes
- Trainings/ workshops for future advocates of the SENSE. methodology (a la teaching educators or others to implement/ spread the model etc.)
- Discussions with experts or various groups of stakeholders and/or beneficiaries on needs, potential of the model, ideas and constraints etc.
- Publications (journals, interviews, …), Communication (social media posts, newsletters, …), exhibitions, etc. – guided by WP2 principles and leads
- …

An entangled combination of those above could also be seen as one implementation activity if this makes sense for reporting (e.g., presentation & discussion with stakeholders).

Implementation Strategy

Each lab draws a ==local implementation strategy== designing how SENSE. activities will be adapted for the local context. Please update your planned events (Table) regularly and report soon after events. This enables WP4 Coordinators to estimate the achievement of certain objectives and the KPIs. The calendar with all planned activities is to be finished by 31.12.2023.

Reporting Activities
All activities are supposed to be reported. This helps your own plannings & overview, allows collaboration & inspiration, enables monitoring, and feeds the report D4.2.

To cause as little as possible additional work, a precise, simple template was designed to serve as basis for reporting any implementation activity. It might be revised from time to time as reaction to results, feedbacks, and other tasks' /WPs' needs.
Find the template here (*not revised yet*).

Report any implementation activity as soon as possible for you, so we do not miss out on information. Upload the report of any implementation activity in MS Teams/ SharePoint in the folder
WP4 STEAM Labs -> Report your STEAM Lab activities here -> *your organization*.
Name the files clearly with date and activity, for example "12.10.23PHWLaunchReport" or "Workshop Teachers PHW 21.11.23" – so documents are easy to find and sort.

All uploaded reports will be listed in a table to easily keep track of KPI progress (stakeholders & evaluation) and Lab activities in general. If possible, add planned activities to the table already (tab for your organization). PHW is responsible for updating the table – to monitor and collate implementation activities in a structured way.

The first thing we crave for some feedback about your local STEAM Lab Launch Event. This report is based on chapter 2.3 of deliverable D4.1.
As this might in most cases be a little different from later lab activities and give some inspiring, motivating, and impressive insights or results, different guidance on how to report from the Launch event was provided and prototyped.
You find the incredibly useful guidance on the launch event for STEAM Labs as well as the Lab Launch Feedback Guidance (giving ideas on collecting feedbacks from your launch event's participants) in the WP4 -> D4.1 folder.
We wanted to leave the reporting from Launch events pretty open to guarantee that we catch all the feedbacks, reflections, results you want to provide without just focusing on foreseen ones. You might also already integrate some evaluation activities, of course (see Co-evaluation plan and guidance for information).
Please feel free to share additional inspiring material (pictures, presentations, flyers...) from your launch events in the "STEAM Lab Launch & Activities" folder by creating a folder named after your organisation.

The report on implementation activities is due on 26.07.24 to go out to revision – so the largest part of reports should be collated by the end of May 2024.

Other Important Notes

For everything you do in the lab, ensure to pay attention to your local and the general Data Management Plan (D1.3), the Ethics Monitoring Plan (D1.4) and especially informed consent, and the SENSE. project's Dissemination, Exploitation, Communication strategy (revised D2.2).

The work in the STEAM Labs heavily relates to multiple tasks/ objectives/ deliverables, thus be aware of other WPs/ tasks/ partners etc. contacting you with their requests. Special highlight and focus within WP4 will be the evaluation actions and tasks for everyone. Thinking of other WPs, especially the consolidation of the Roadmap (WP7) and the WPs about our cross-cutting issues Space (WP5) & Social Inclusion (WP6) will reach out to many of you. Also, we all provide content and results for WP2.

Care to embed citizen science and art science interventions.

Draw and report a local implementation strategy for Lab activities until end of 2023. Do not forget to test at least 2 sequences from other labs in your labs.

Further information, for example about involving / addressing / reporting about your cluster topic, is still to be discussed and implemented. This document is dynamic!

Annex 2: Presentation of required reports, due dates, and upload structure
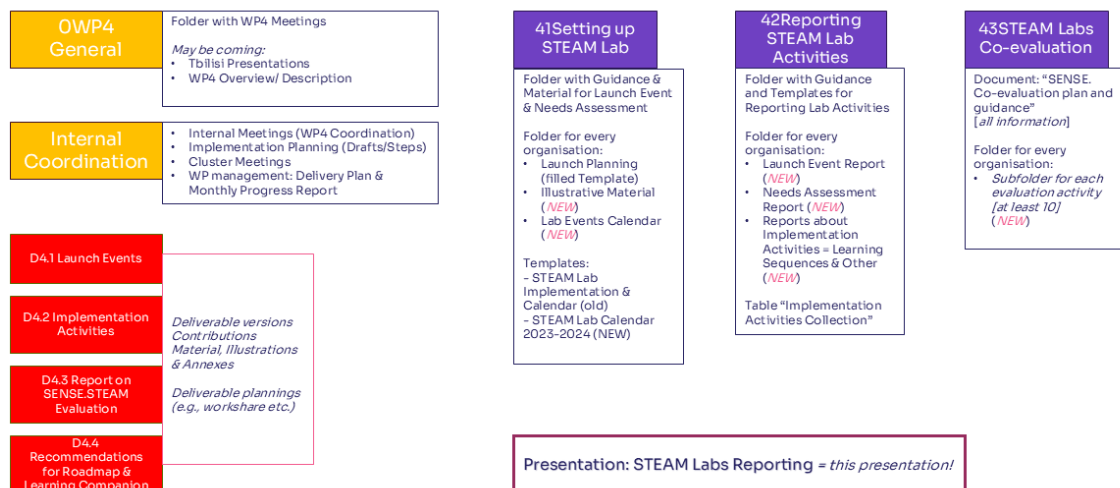
Required Reports & Due Dates

WHAT	HOW	WHO	WHEN
1 Launch Event Report (decide if you split it in more than 1 report)	• Implementation Activities Reporting Template (doc) • STEAM Labs Implementation Activities Collection (table)	Each STEAM LAB	30.11.23
1 Needs Assessment Report (needs assessment as important part of setting up the labs, will be addressed in further activities & reports)	• Individual Reporting depending on local context (doc for needs assessment) • STEAM Labs Implementation Activities Collection (table)	Each STEAM LAB	31.12.23
1 Calendar of planned Events (Calendar from Launch Event Planning to be continued)	• Template – STEAM Lab Calendar 2023-2024(doc) • Put planned activities in STEAM Labs Implementation Activities Collection (table)	Each STEAM LAB	31.12.23
∞ Implementation Activity Reports (Learning Sequence with evaluation *or* other implementation activity)	• Implementation Activities Reporting Template (doc) • STEAM Labs Implementation Activities Collection (table)	Each STEAM LAB	always

Care: For evaluation reporting see the "SENSE. Co-Evaluation plan and guidance"!
THIS IS JUST ABOUT COLLECTING & MONITORING ALL ACTIVITIES IN THE LABS

Folder Structure of "WP4 STEAM Labs"
(MS Teams // SharePoint)

0WP4 General

Folder with WP4 Meetings

May be coming:
• Tbilisi Presentations
• WP4 Overview/ Description

Internal Coordination

• Internal Meetings (WP4 Coordination)
• Implementation Planning (Drafts/Steps)
• Cluster Meetings
• WP management: Delivery Plan & Monthly Progress Report

D4.1 Launch Events

D4.2 Implementation Activities

D4.3 Report on SENSE.STEAM Evaluation

D4.4 Recommendations for Roadmap & Learning Companion

Deliverable versions Contributions Material, Illustrations & Annexes

Deliverable plannings (e.g., workshare etc.)

41Setting up STEAM Lab

Folder with Guidance & Material for Launch Event & Needs Assessment

Folder for every organisation:
• Launch Planning (filled Template)
• Illustrative Material (*NEW*)
• Lab Events Calendar (*NEW*)

Templates:
– STEAM Lab Implementation & Calendar (old)
– STEAM Lab Calendar 2023–2024 (NEW)

42Reporting STEAM Lab Activities

Folder with Guidance and Templates for Reporting Lab Activities

Folder for every organisation:
• Launch Event Report (*NEW*)
• Needs Assessment Report (*NEW*)
• Reports about Implementation Activities = Learning Sequences & Other (*NEW*)

Table "Implementation Activities Collection"

43STEAM Labs Co-evaluation

Document: "SENSE. Co-evaluation plan and guidance" [*all information*]

Folder for every organisation:
• *Subfolder for each evaluation activity [at least 10]* (*NEW*)

Presentation: STEAM Labs Reporting = *this presentation!*

Upload of required Reports
Take care of a coherent and precise naming

WHAT	Document	Folder	WHEN
Launch Event Report	• Implementation Activities Reporting Template (doc) • STEAM Labs Implementation Activities Collection (table) ▦	📁 "42Reporting STEAM Lab Activities" → folder of your organisation 📁 "42Reporting STEAM Lab Activities" → Table (scroll down)	30.11.23
Needs Assessment Report	• Individual Reporting depending on local context (doc for needs assessment) • STEAM Labs Implementation Activities Collection (table) ▦	📁 "42Reporting STEAM Lab Activities" → folder of your organisation 📁 "42Reporting STEAM Lab Activities" → Table (scroll down)	31.12.23
Calendar of planned Events	• Template – STEAM Lab Calendar 2023–2024(doc) • Put planned activities in STEAM Labs Implementation Activities Collection (table) ▦	📁 "41Setting up STEAM Lab" → folder of your organisation 📁 "42Reporting STEAM Lab Activities" → Table (scroll down)	31.12.23
Implementation Activity Reports	• Implementation Activities Reporting Template (doc) • STEAM Labs Implementation Activities Collection (table) ▦	📁 "42Reporting STEAM Lab Activities" → folder of your organisation 📁 "42Reporting STEAM Lab Activities" → Table (scroll down)	always
Illustrative Material (especially from Launch Event)	• Pictures, Presentations, Material, … (translated?) to illustrate articles	📁 "41Setting up STEAM Lab" → folder of your organisation	depends
ANY EVALUATION	Create folder for each evaluation action	📁 "43STEAM Labs Co-evaluation" → folder of your organisation	always

Annex 3: Implementation Activity Reporting Template

SENSE. Implementation Activity Report

Each activity happening in a STEAM Lab contributes towards implementing our model & methodology. In order to assess the validity of our approach, it is important to assess the extent to which it reaches a variety of stakeholders; hence in this report we collate key information about each implementation activity, including evaluation and stakeholder involvement, which will feed into D4.2 and the development of the roadmap with all its toolkits and companions. More information in the Guidance.

PLEASE NOTE: Implementing learning sequences includes an evaluation activity while other implementation activities do not.

For learning sequences fill the general information and Part 2.

For other implementation activities fill the general information and Part 1.

CARE: Both kinds must be listed in your activity collection in the table.

GENERAL INFORMATION			
STEAM Lab(s) & Partner(s)		Contact for this action/ activity	
Location(s)			
Activity Title	Chose a clear title for the activity you report about (Example: "Discussing local needs with PHW Stakeholders")		
Period of Activity	Add all relevant dates (incl. time/ durations)		
Activity Category (tick / explain) If the implementation activity you report about was a learning sequence, fill Part 2. If else, fill Part 1.	Learning Sequence with evaluation (fill Part 2!)	Dissemination/ Awareness (presentations, publications, practices, happenings…)	Discussion (experts, stakeholders…) on needs, potential, ideas, constraints…
	Trainings/ Workshops for users of SENSE.	Networking/ Policy Making/ Advocacy	Other:
Participants For some activities this does not apply (e.g., posting an article). Do as appropriate. Beneficiary description in D3.3, chapter 2. [*page 16*]	All participant details must be noted in the Excel table 'STEAM Labs Implementation Activities Collection'. LINK. Fill in the information about overall numbers, the various beneficiaries this activity addressed, and the participants' social composition. Care: - Persons can fit more than 1 category - Gender & social affiliation (if they identify as members of a disadvantaged minority) should be self-chosen – and *not* assumed - Not every detail is always asked – depends on context		

External Stakeholders from Description of Action (B), section 1.1, KPI2.2. [*page 12*]	Fill in the information about involved external stakeholders. This is mandatory to track KPI2.2. Care to count each stakeholder only once (2 activities with the same school = 1).

PART 1: Implementation Activity that is NOT a Learning Sequence – Report
Fill if the implementation activity you report about has not been a Learning Sequence.
Link to Excel Spreadsheet to collect implementation activities.

Implementation Activity Description	Answer if **not** a learning sequence.
	Please describe in 100 words max. (exceptions if needed).
	   1. *What the activity consists of*
	   2. *Your goals and considerations for doing it (possibly following the needs assessment)*
	   3. *Reactions / responses from participants (if known)*

PART 2: Implementing a Learning Sequence – Report
Fill if the activity you report about has been a Learning Sequence with Evaluation.
Link to Excel Spreadsheet to collect implementation activities.

Approach (*tick / explain*) *Each lab is supposed to apply 2 sequences from other labs*	*Pre-designed sequence*		*Adapted sequence*	*Own design*
	Sequence from another Lab*		*Other (describe):*	
Description	*Describe the learning sequence.*			
Rationale for the sequence	*Explain your choice of the learning sequence.* *In what ways does the rationale build upon the needs assessment?* *In what ways does the rationale build upon the elements of the SENSE. manifesto?*			
Evaluation Data: Evaluation design and data type (*tick / explain*)	Post Test: __ *Survey?* *Survey and notes?* *SENSE. Evaluation activity? (If so, please specify)*	Pre & Post Test: __ *Survey?* *Survey and notes?* *SENSE. Evaluation activity? (If so, please specify)*		Pre & Post Test with follow-up study: __ *Survey?* *Survey and notes?* *SENSE. Evaluation activity? (If so, please specify)*

Facilitators' notes Pre-activity	Focus on: SPACE				
		Description	Pre-activity Priority Rating (0-5) from not important to very important	Post-activity Priority Rating (0-5) from not important to very important	Comments post-activity

General	e.g. standard classroom			
Function				
Appearance				
Environmental Control				
Spatial Configuration				

Things to consider about each category while filling the above table-

General – As it has been reiterated in the WP 5.1 Scoping Report, there is no magic formula for STEAM spaces, only magic conversations. Does this space have the ability to encourage these dialogues? Does it trigger interaction, collaboration, reflection, discussion, and experimentation? How does the space for every user and does it have the capability to transform according to its users evolving needs?

Function – Does the space provide essential functionality? Do they cater to the users needs? How would this function when a STEAM curriculum is implemented within this space?

Appearance – What is the look and feel of the space? How do they make the users feel? Does it provide essential feelings of comfort, safety, and approachability? Does the space seem to be culturally coded (eg: particular symbols in the classroom)?

Spatial Configuration – What were the structural elements of the space like? What was the ceiling height- was it an appropriate for the activity to take place in? Was there visual control for the users within the space- eg; were they able to control where they places themselves in a room to engage with the activity? Was it a big open space or a carefully configured space that dividing users into smaller groups? Reflect on the role the physical space had in the success of the activity/ experience of its users.

Environmental Control – What are the light conditions? How does the place smell? What are it acoustic capabilities like? Would neurodiverse participants feel included in this area while experiencing low visual stress levels? Is the space malleable to cater to the certain "hacks" that may be needed for certain STEAM activities? Focus on more metaphysical elements that would impact the spatial configuration of the space and thus the experience of its users.

- SOCIAL INCLUSION

First, during the SENSE. Activities, facilitators should begin with a self-reflection process. The exercise consists of asking yourself four

general questions at three different levels, using the lens of social inclusion. *When filling out this table, refer to the document Samples & Examples for the Evaluation & Monitoring Template.

Question:	Individual (e.g., students or participants	Community (the group with which the STEAM lab is working)	Society (the environmental conditions and context of the STEAM labs)
Who?			
Why?			
What?			
Where?			

Second, identify 5 elements that are most relevant to each activity and why. Which were the 5 most challenging and why? Refer to Tables 3 & 4 in the D6.1 Scoping Report or within the Summaries Social Inclusion.

Elements of Social Inclusion	Relevant? Indicate 5 Yes & 5 No	Why?
Equal Participation		
Gender balanced representation		
Amplification of certain voices		
Flexibility & accommodation needs		
Gender-sensitive data collection		
Future making		
Sensorial experiences		
Continuous Professional Development		
Feedback & Adaptation		
Community Engagement		

	Intersectionality Consideration		
	Stereotypes & Bias		
	Inclusive Language		
	Flexible Assessment		
	Mentorship & Support Groups		
	Equitable Access to Resources		
	Inclusive Teaching Activities		
	Mutual Learning & Knowledge Exchange		
	Co-Creation & Cooperation		
	Diverse Representation in curriculum & learning sequences		
	- DISPOSITION TOWARDS SCIENCE LEARNING		
Facilitators' notes Post-activity	Activity – Focus on: - How (far) the activity generated involvement, engagement, excitement (personal contributions; changes in attitudes and dispositions; opportunities to learn new skills; learning about oneself and others; …) - How participants reacted to the activity (emotional response, verbal feedback, …) - How potentially excluded groups were addressed - How participants engaged with science Reflection – Focus on: *What went well? What would you do differently? What was unexpected? What conclusions/ lessons/ comments for future STEAM Lab activities occur?*		

Connection – Focus on – please rate from 1 to 5, from not important to very important

How does it integrate SENSE. educational key components (D3.5 sec. 3.1):	Rating	Comments
learner centeredness		
reflective feedback		
STEAM inquiry (artistic & scientific relation)		
citizen science / citizens involvement		

These categories are drawn from "Educational key components in SENSE." as described and defined in D3.5 Sense Methodology, page 30. D3.5 SENSE. Methodology

- Once reflection on social parameters is conducted, go back to the Spatial Reflection table and rate your learning sequence post-activity.

Facilitators' notes Follow-up study *To be used if this activity is evaluated with 2-month post*	To be used if this activity is evaluated with 2-month post Focus on: - Anything important in regard of the notes taken post activity (changes, new outcomes, reflections, …) - General memory of the activity and what felt memorable in the long-term - Any permanent changes to the space - Involvement and Feedback of other groups

Annex 4: Monitoring Key Performance Indicators

- "KPI 2.2: Implementation activities will involve at least 30 schools, 20 research institutions, 12 policy-making initiatives, 10 companies, 15 municipalities, 12 (science) museums and 25 artists or art collectives as external stakeholders directly contributing to evaluating learning sequences." (DoA (part B), p. 12)

The data reveals a total direct involvement of 136 schools, 75 research institutions, 25 policymakers, 37 companies, 33 municipalities, 22 (science) museums, and 27 artists or art collectives. Thus, the goals set by the KPI2.2 were reached.

- "KPI 2.3: A minimum of 100 documented implementation activities for evaluation" (DoA (part B), p. 12)

The KPI2.3 about the evaluation of learning sequences targeted the goal of at least 100 documented implementation activities for evaluation. We could verify at least 112 of them, meaning that the goal was potentially achieved. For more information see report D4.3.