SENSE. The New European Roadmap to STEAM Education

D4.3 – Report on the SENSE.STEAM evaluation of the four specific areas

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Abbreviations and acronyms

Abbreviation or acronym used in this document	Explanation
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEAM Lab	Science, Technology, Engineering, Arts and Mathematics Laboratory
DigComp	The Digital Competence Framework (DigComp) provides a common understanding to identify and describe the key areas of digital competence.

Glossary

Term	Definition used or meaning in the SENSE. project	Reference if applicable
Co-evaluation	We use the term Co-evaluation to recognize that all participants were included in this process throughout their time participating in the STEAM Labs.	D4.3
Body portraits	It is a visual method that participants can use to express - by means of drawing and symbols - the elements of a significant learning experience.	D4.3
Portraitures	We use this term to refer to a qualitative, arts-based method used to describe the experiences of the different STEAM Labs as 'rich pictures', incorporating visual images, context and storylines.	D4.3

Reliability	The term refers to the trustworthiness of a set of research results.	D4.3
Validity	The term refers to the extent the methods are deemed to measure what they claim to measure. The validity of the results is dependent upon the validity of the methods.	D4.3
Internal Validity (also termed transformational validity in qualitative research)	We use this term to refer to conceptions of transformational validity, that is, the extent to which the results are validated by higher level of self-reflexivity and their potential for a redefinition of the status quo.	Cho, J. and A. Trent (2006). Validity in qualitative research revisited. Qualitative Research 6(3), 319–340.
Aesthetics	In this project aesthetics refers to the realm of the senses and the engagement of a sensorial (aesthetics) perception in science as well as in art.	D3.5 & D4.3

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.STEAM’ future science learning will be moving away from the standardised classroom shapes and furniture layout entering new learning landscapes.

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 It addresses outdated perceptions of current science education as well as gender stereotypes by integrating the arts, social inclusion and spatial design as its core components.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

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

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

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Executive Summary

This document summarises the design and main findings from the co-evaluation conducted during the implementations of the STEAM Labs (October 2023 through to 31st March 2024). Because of the importance of future-making as an educational, activities were designed to be creative, open-ended and unique to context including place, community, time and the people and institutions involved. Different methods were used to activate and to integrate different senses and ways of working, while the participatory process was key to interpret and to make sense together of what had happened and thus to grasp the relevant and impact of SENSE across the consortium. Given the transformative ambition of the project, the evidence of impact is used as a measure of both progress and potential, with respect to the three key principles of the SENSE. roadmap (Awareness, Action and Advocacy) and for advancing key EU policy priorities (Health, Green Deal, Digitisation and work-readiness).

Key messages:

SENSE. proved to be a flexible and adaptable methodology which addressed participants needs across different contexts. Specifically in relation to:

1. The evaluation methodology is effective and employs an appropriate approach to assess impact and adaptability of SENSE. educational content and material.
2. The SENSE approach resonates particularly well with female participants.
3. SENSE is designed to engage learners of all ages equally.
4. SENSE reduces boredom in STEAM learning experiences by making them more engaging.
5. SENSE generates awareness of key policy areas, achieving work readiness and heightened awareness of environmental issues.
6. SENSE provides practical strategies to sustain engagement, such as partnerships with employers.
7. SENSE offers diversified suggestions for science education beyond the classroom, enhancing inclusion among different groups.
8. SENSE is socially just, demonstrating applicability in diverse countries and contexts.
9. SENSE can be aligned with national school curricula, covering topics like optics, sound, scientific instrument handling, data analysis, technological design, biodiversity, and climate.
10. SENSE addresses the learning continuum by being successfully implemented in schools, higher education, vocational education, and informal education settings like museums and science centers.

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1. Introduction

This document reports on the evaluation of impact of the SENSE.STEAM methodology as implemented across the 13 STEAM Labs. Specifically, this document highlights progress across four EU policy areas, including supporting gender equality in STEM.

1.1. Purpose of the document

The purpose of this document is to describe the premises behind the design of the evaluation and the principles driving its implementation. Given the transformative ambition of the project, this document discusses the evaluation strategy as a tool for taking forward a more expansive idea of education through STEAM approaches. The evidence of impact is used as a measure of change, with respect to the potential of STEAM education to advance matters of societal relevance.

1.1.1. Data collection and evaluation

Evaluation was integrated at all stages over the course of the project. As described in D3.3 (methodology) and in D4.2 (report on the implementation activities), evaluation strategies were deployed to inform:

1. Project partners' understanding of the methodology and guide its implementation;
2. STEAM Labs' participants' understanding of the impact of the activities on themselves;
3. Project evaluation team's understanding of impact in line with four key policy areas (Green deal; Health; Work Readiness; Digitisation).

In order to capture impact during and after the implementation, a set of multiple data collection methods was used to address the above objectives as follows:

- A protocol for data collection designed to gather facilitators' reflections during the implementation phase;
- A set of arts-based methods integrated within learning sequences to generate participants' reflective feedback during and after the activities;
- A set of pre and post questionnaires designed to capture longer-term impacts.

Through this approach conducted over time we gained insights into the dimensions of the SENSE methodology that garnered greater involvement from participants across settings, and some lessons learnt about the strength of this methodology to advance progress across four interrelated EU policy areas.

1.2. Intended readership

The primary intended audience for this deliverable is constituted by EU policy officers as well as policymakers operating in the specific countries where the implementation took place.
In addition, given the adaptability of the evaluation design, this document is addressing educators and other stakeholders interested in empirical evidence of impact from projects that integrate arts-based research methods.

1.3. Structure of the document

The first part of the document details the overall evaluation strategy, and the techniques used during the implementation. In the middle section we illustrate the impact across the different Labs and the final section provides key findings and conclusions.

1.4. Relationship with other deliverables

This deliverable incorporates the design principles for the SENSE.STEAM methodology developed in WP3 (D3.3 and D3.4) and illustrates the impacts from the design and implementation of activities described in D.4.1 and D.4.2. In addition, it provides pointers for the design of specific evaluation protocols to capture impact from the longer-term engagement with and implementation phase of the roadmap (WP7).

2. Pathways to Impact. For more "Co" in Evaluation

2.1. Co-Evaluation

In this project we worked to create an educational approach designed to have impact in society. In the year of the STEAM Lab implementation phase, we adopted co-evaluation measures to gather evidence of impact from the proposed activities and we extracted key lessons for their adaptation to meet policy priorities and needs in different contexts.

We use the term Co-evaluation to recognize that all participants were included in this process throughout their time participating in the STEAM Labs. This is crucial in order for a methodology designed to bring change to actually generate change, starting

from enabling involvement and agency from all participants involved. For us, this means a process by which hierarchy is minimised as much as possible between coordinators, organisers and participants, and the goals are to include voices and experiences from all equally.

To this aim, we adopted a Design-Based Research (DBR) approach, which focused on a set of *conjectures* about the potential outcomes associated with the SENSE.STEAM approach. Differently from traditional quantitative studies which are based on gathering evidence to support or refuse a set of hypotheses established at the outset, the term 'conjecture' points to a set of possible and desirable impacts, all equally valid, that are defined according to context. There is an element of openness that makes this approach suitable for use across different cultural and social settings. As succinctly illustrated by Hoadley and Campos' article (2022):

> "DBR attempts to understand the world by trying to change it, making it an interventionist research method. However, DBR problematizes the designed nature of interventions, recognizing that the intended design is different from what may be enacted in a complex social context, one in which both participants and designer-researchers have agency" (Hoadley and Campos, 2022 p. 211).

In practical terms, this meant that in our DBR approach we could include multiple co-evaluation activities that facilitators of STEAM Lab activities integrated within the design of their learning sequences. These co-evaluation activities had certain requirements:

- Creative, and designed to generate personal interpretation and imagination;
- As open-ended as possible;
- Appropriate and adaptable to context and audiences;
- Short (15 minutes before and after max), and requiring no or minimal translating

Given the size of the consortium, its diversity, and the scale of the implementation with a minimum KPI to evaluate at least 100 activities, the co-evaluation strategy adopted a flexible approach incorporating both pre-designed data collection instruments and newly designed or adapted ones to suit specific conditions throughout the implementation period. Altogether, these methods are designed to capture short-term and longer-term impacts, as well as emotional and cognitive impacts. Their design and combined use are described in more detail in the next section.

2.2. Methodological pluralism and integrated approach

Traditional assessment methods and evaluation tools often fail to bridge the gap between formal science education and the lived experiences of individuals in informal and non-formal learning environments. As detailed in our methodology (D3.3 and D3.4) the central pillar of the SENSE. methodology is to enable participants to learn from direct experience. This means moving away from the use of abstract models and concepts, and engage participants through their senses, as they provide important information about how different people understand the world and value their experiences of education, and how spaces can be used and designed to enable greater inclusion. For this reason, the evaluation framework integrated a set of methods that were directly associated with the senses and that for this we call *'aesthetic methods'*, alongside other structured methods designed to capture overall changes of practice.

Key to the reliability of this integrated approach is its multimodal and aesthetic approach, which allows for comprehensive data collection from diverse sensory experiences and holistic assessments. The validity of the method is enhanced by its alignment with co-evaluation and inclusive practices, ensuring that the framework accurately reflects the lived experiences and educational needs of participants in formal and informal settings.

By incorporating co-evaluation methods, the project sought to provide educators and policy makers with deeper insights into the nature and design of educational strategies that resonate with both students and the wider community. This was particularly relevant in this project and its ambition to support progress on environmental, social, and economic priorities, for example through quality education and gender equality (SDGs 4 and 5), sustainable cities (SDG 11), responsible production and consumption (SDG 12), and climate action (SDG 13). By engaging students and citizens in these critical areas, we can illustrate the opportunities within policy initiatives that already exists, such as the Green Deal, Work Readiness, Digitisation, and Health to empower individuals to participate in shaping sustainable futures.

Furthermore, the integration of aesthetic approaches within a co-evaluation approach is also serving the purpose of modernise the culture of assessment in schools and higher education, to create a more inclusive and dynamic research and innovation system. Inclusivity here is extended to gender equality, ensuring that the European research and innovation system benefits from diverse perspectives and experiences and research is more closely aligned with societal needs, expectations, and values.

To this end, a flexible approach featuring co-existence of aesthetic/multimodal tools invites and enables participants to use words, drawings as well as mapping techniques and photographs complemented by reporting from facilitators. All together forming a multi-modal methodology for holistic assessment in complex learning configurations such as STEAM. This alignment is of paramount importance for the fostering of a society that values and supports scientific and civic endeavors through equitable educational practices.

2.3 Co-Production in the STEAM Labs

In line with the participatory and co-produced model of evaluation, all evidence gathering activities took place in situ, across the 13 STEAM Labs.

2.3.1 The Labs

The term 'Lab' is used here to indicate a site where participants gather in order to explore and address a theme or a topic that is deemed to be important to them. While in the anglophone world the word 'lab' is reminiscent of the science laboratory in which experiments are conducted under controlled conditions, in this project, we refer to the use of the word in the francophone world of education as the *laboratoire des idees (laboratory of ideas).* 'Lab' in this sense is all at the same time a physical, intellectual, imaginary and an experimental space, that may be situated and happening as a set of interactions within a school or in an informal learning environment such as a museum or an after-school club. What matters is that within a lab, participants can practice with activities designed to engage the senses, explore and understand the influence and role of space in shaping possibilities for learning, and become more aware of the needs and experiences of different people and groups.

2.3.2 Feedback and Evaluation

Drawing upon the richness and diversity of the consortium, our co-evaluation activities were designed to work as integrated elements within learning sequences. These included an activity featuring sciences and arts, plus an evaluation activity, that could be conducted before, during or at the end of the sequence/or set of sequences. In this way, evaluation worked both as a local measure and feedback to guide participants' understanding and the development of practice as well as a cumulative measure for global appraisal of impact across the Labs.

In each lab, facilitators could start from a suite of activities that the consortium had originally shared over the course of the first year of the project (see D3.3 and D3.4), drawing on their own personal experience and practice of STEAM. From this initial bank of activities, we extracted some level descriptors providing an indication of how far the activity could move the implementation along a transformative continuum,

from STEAM as a means to transfer scientific content to STEAM as future-making endeavour designed to bring about change. This earlier categorisation was by no means aimed at classifying abilities or setting standards to test the range of impacts at the outset, but it was used as a heuristic method both to orient participants with respect to the multiple configurations of STEAM and to inform the global evaluation around the nature of the impact that occurred in relation to the original conditions (Table 1).

Table 1: the 3 levels of practices

1	**Instrumental use** Senses are used to detect and collect information about the world	In what way can disciplines combine to deliver set curriculum topics? → Arts are deployed to compensate for deficit, and/or focus attention to specific elements of knowledge decided a priori.
2	**Infusion approach** Senses are starting points to relate to and act in the world	In what way can the arts facilitate attention and interest in science and/or aid the presentation/exposition/interpretation of scientific content? → Arts are used to expand the range of affordances available in a space and to engage the senses in different ways (*as seeing things anew*).
3	**Future-making** Senses as affective modalities to associate, empathize and co-exist with others in the world	Arts and Sciences work together in questioning the assumptions of how humans conduct themselves in the world. → Priorities, Design and planning stem from the needs of those involved and/or the community own needs.

In addition to the prepared materials, there was also an opportunity for all partners to continue devise new activities and new sequences as they gained further familiarity with the method. The new materials and prototyped implementations were then shared and discussed amongst all partners during the regular Friday's sharing labs ateliers (Figure 1).

Figure 1: Devising, adapting and sharing designs in the STEAM Lab Friday's sharing labs ateliers.

So conducted, the co-evaluation process was thus a co-production process which responded to the needs and requirements that each Lab had identified as being relevant for their participants and contexts (see D.4.1 and D4.2), while enabling possibilities to continue to expand the provision to create new opportunities and meet new needs. In this model, evaluation activities are not simply an end point, but they were opening up to possibilities, provided feedback at interim stages and/or informed the assessment of next steps for follow up events (Figure 2).

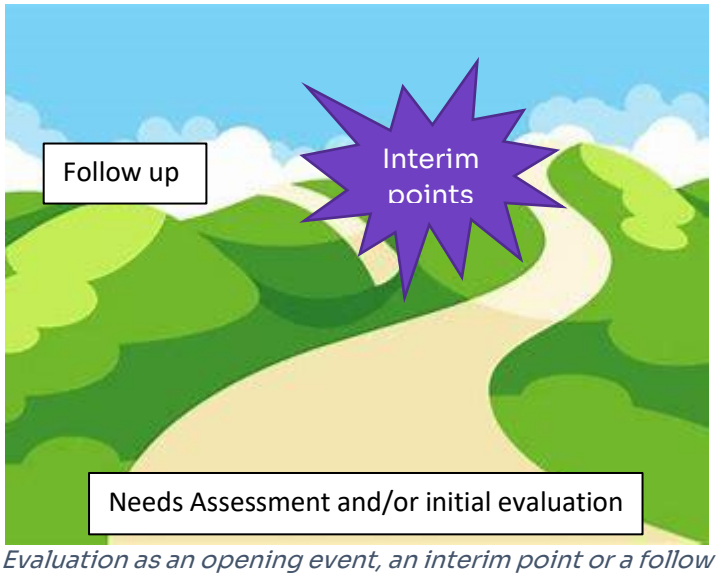


Figure 2: Evaluation as an opening event, an interim point or a follow up event

2.4 Co-existing methodologies in the testing battery

The Co-evaluation and co-production of learning sequences worked together as the two key features of the SENSE.STEAM process. Because of the importance of future-making as an educational, activities were designed to be creative, open-ended and unique to context including place, community, time and the people and institutions involved. Different methods were used to activate and to integrate different senses and ways of working, while the participatory process was key to interpret and to make sense together of what had happened and thus to grasp the relevant and impact of SENSE across the consortium. In practice, the co-evaluation process run throughout the period of implementation covered by WP4; first it included the needs assessment which led to the setting up of the STEAM Labs (see D4.1) and formed integral part of the guidelines in the resulting learning companion (D4.2 and D7.2).

For the more specific purpose of assessing impact, the collection of evaluation measures started when the Labs were established and covered the period from October 2023 through to 31st March 2024. The overall process integrated and combined both qualitative and quantitative measures; it included fixed points for data collection within an overall flexible framework, and it developed over time, through the co-production of new learning sequences. The overall evaluation framework is visualised in Figure 3 below.

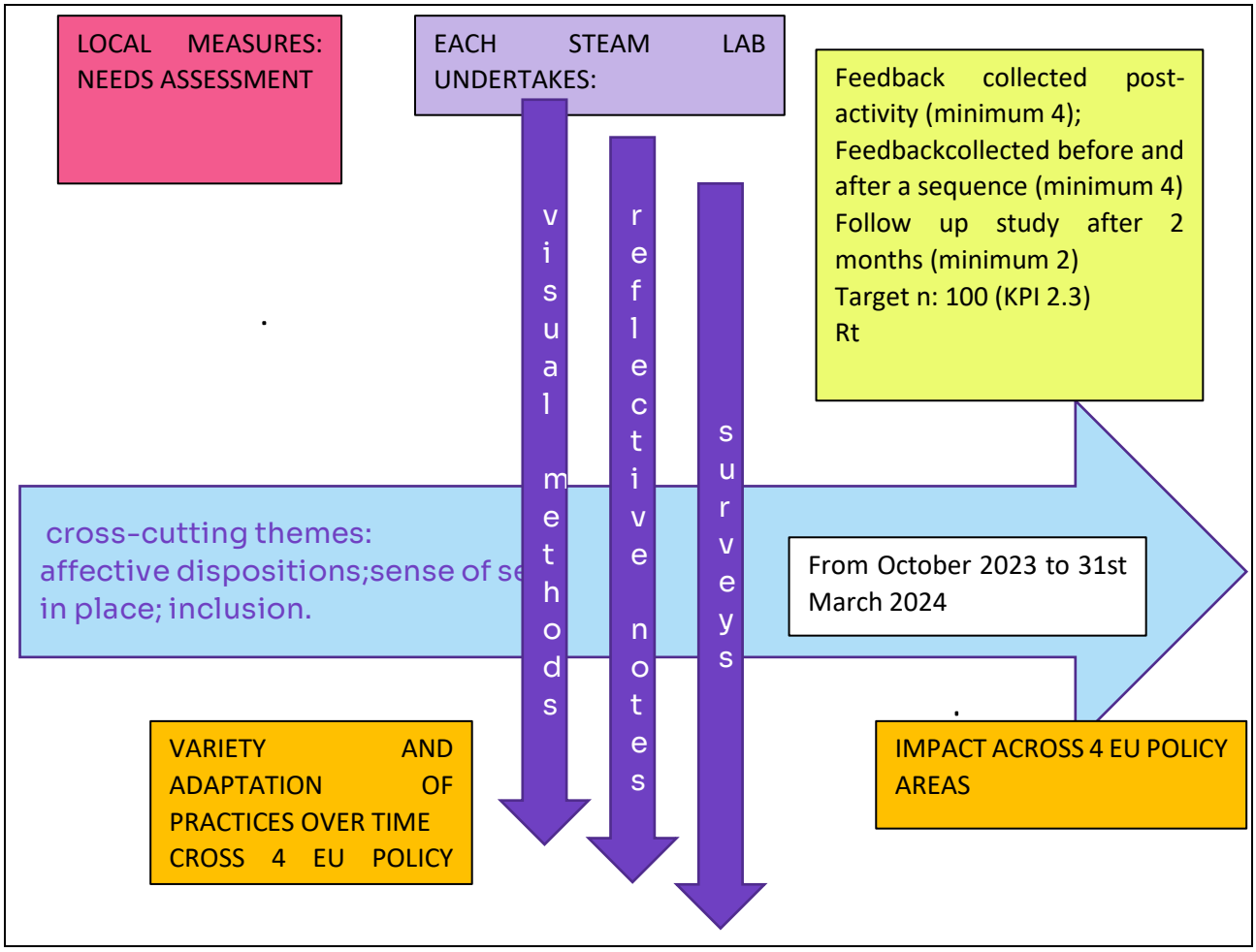


Figure 3: Overview of the Co-Evaluation process

2.5 Creative methods in social research

The evaluation framework of the SENSE.STEAM process was set out to produce a rich picture of the extent to which a different approach to science education which integrates the arts may be a vehicle to bring fundamental and foundational changes in educational settings across Europe. This aim is also at the root of the project's ambition to view education as a transformative force which will impact not only on the individual experiences of participants in their own particular contexts, but also collectively, touching upon the different spheres of health, economics, environment and technology as priorities identified at the European level.
With the intent of producing such rich picture, the evaluation can thus be understood and summarised with two visual metaphors:

- As a series of *portraitures,* giving an insight into some of the specific methods used and respective levels of involvement of participants in the different Labs. These portraitures are derived from assembling information from the facilitators'

reflective notes, a series of body portraits (or body mappings) and additional quantitative and qualitative measures (as further described in 2.6 and 2.7). As reported by Travis (2020), portraiture as a methodology goes beyond visual representations of individual subjects or units to create a portrait that conveys the complexity of the contexts, narratives, and practices within a phenomenon or situation, seeking a balance between generalizability and particularity within research. Specifically, citing Lawrence-Lightfoot and Davis (1997), the portraiture sits at the intersection between arts and sciences, and it is guided by the dual motivations to inform as well as inspire; to document but also to transform, to speak to the head and to the heart.

- As a global picture of impacts across the consortium. With consideration of the size, diversity and geographical distribution of partners and associate partners, impact measures are derived from an exercise of scale, with the consortium offering a micro-cosmos of impacts that can be extrapolated at a global level.

The use of visual language here (pictures; portraitures) is important in communicating the complexity and richness of the approach and its findings. We did not set out to measures outcomes at priori, but we took the road less travelled to explore and expand on the boundaries of the possible, seeking to integrate both “the coded and the colourful” (Lawrence-Lightfoot and Davis, 1997) and create accounts which revealed potentialities and limitations of the methods as well as their immediate effects. With this in mind, the results are presented with a view to account for the diverse storylines of the project (Figure 4).

Edinburgh Steam Lab story... comes together with other stories...

To map progress and impact on a global theme.

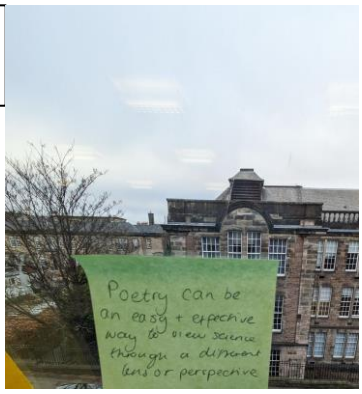


Figure 4: Creative assembling of data and stories

2.6 Sensory portraits for co-evaluation of educational approaches

Our first exploration of the portrait silhouettes as a method for qualitative evaluation of the impact of SENSE. STEAM Labs came from an article on 'language portraits' (LP) "as a research method to investigate the embodied multilingual repertoires of people who use both spoken a signed language" (Kusters and De Meulder, 2019; link to the paper here). The specific image of the portrait silhouette that we use is from Kusters and De Meulder in that paper (Figure 5). They describe the figure as the "*abstract gingerbread-man, with little gender-specific details and no clothing, but also not "naked" (e.g., no toes are visible)"* (Busch, 2018).

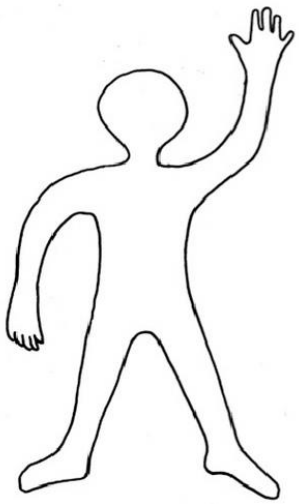


Figure 5: Portrait silhouette, imported from (Kusters and De Meulder, 2019)

While extensively used and studies across different settings than the SENSE. project – for example in investigating experiences of translingualism (Busch, 2021; Mu *et al.*, 2023) and intercultural communication (Krumm and Jenkins, 2001; Krausneker, 2004) – there were elements of the language portraits that we found useful and relevant to the goals of co-evaluation of the impact of the STEAM Labs, because of the potential of being:

A. Multimodal; allowing for the use of visual, symbolic and verbal language together;
B. Immediate; it can be understood without the need to translate;
C. Versatile; Often used with a combination of methods, such as surveys post-activity;
D. Flexible; Used in multiple settings and contexts – schools, teacher training, psychotherapy, contexts including migrant groups, indigenous groups, and more;
E. Holistic; The goal is to show embodied experiences and how the present connects with historical and cultural experiences;
F. Prompt dependent;
G. Explores lived experience.

These characteristics made the choice of method suitable for this project that focuses on diversity of experiences (i.e. gender; cultures; languages; social norms etc) and the importance of the senses to understand how participants may approach their own education, especially with regards to science.

2.6.1 Body mapping

The second focus of our attention is the literature is how it connected with ideas of body mapping, a method developed first in the 1980s. A systematic review can be found here: “Embodied Ways of Storying the Self: A Systematic Review of Body-Mapping” (de Jager *et al.*, 2016). This systematic review is useful as a resource, but we draw a few important elements from it to concisely describe how it informs our practice. “Whole-body mapping involves tracing around a person's body to create a life-sized outline, which is filled in during a creative and reflective process, producing an image representing multiple aspects of their embodied experience.” (p. 1)

This method is extensively used in social work and health research and is a visual method whereby the body is drawn and participants—following moderator prompts in a workshop setting—add onto it their emotions and experiences. The drawing helps generate visual data that can be shared while also having the participant directly explain the representation of the body in space. Through body mapping, data are co-constructed in a participatory fashion by participants and facilitators (de Jager et al. 2016).

Accordingly, social justice and ethical principles underpin this methodology, the goal of which is to propel participants’ firsthand narratives. Additionally, because data are created in a format that can more easily be disseminated and shared back to the originating community, body mapping can be used as a form of collective awareness and facilitate advocacy. For instance, examples of body mapping conducted in this project showed the heightened emotions of being in an outdoor environment but also, the importance of considering high and low body states, for example due to tiredness or hunger (Figure 6). For a detailed account of how practitioners and consortium partners applied this method in the SENSE Labs see Appendix 1.

Figure 6: Sensory portraits sometimes express primary needs, such as being hungry, tired or cold. In this example from VilVite (06 LS), "sulten" translates to "hungry".

2.7 Survey questionnaire

We also included a survey questionnaire that is designed to quantitatively evaluate the impact of STEAM Lab activities. This survey consisted of three dimensions - interest, wellbeing and boredom – measured on a five-point Likert scale (1 = not at all to 5 = very much) and a short demographic information section. For example, for the subscale boredom:

- I felt bored.
- Today, I was sometimes absent with my thoughts.
- The lesson was to sleep in.
- The lesson took ages.

The full text of the survey is available in the appendix.

2.8 Follow-up and reflection evaluation

The two-month follow-up was based on the specific events that took place in each STEAM Lab and on the methods used for pre- and post-evaluation. For every learning sequence evaluated with the 2-month follow up, we collected detailed reflections from the facilitators and those that designed the learning sequence, both in writing and in short interviews/conversations with the evaluation team. The prompts were designed to work as a dialogue around the extent to which the activities generated greater awareness of the role of the senses, the physical space and the extent to which participants felt included. The full text of the questions and prompts for reflection is given in Appendix 4.

2.9 Ethics

2.9.1 Ethics and data management reminders

All evaluation activities complied with the ethical practices of the SENSE. project. This included the requirement for all participants to give informed consent to participate, with this including information sessions and signing of consent forms. For participants under the age of 18 permission was also sought from their parents and guardians (cfr D1.4 SENSE Ethics Monitoring Plan). In accordance with the guidelines set out in the Data Management Plan all personally identifying data was processed by the specific STEAM Lab institution and was not to be shared on the Teams or sent to WP4 coordination team.

3. Co-evaluation analysis and results

This chapter explores the outcomes from implementing the SENSE. approach in the local STEAM Labs, aimed at bridging the gap between formal science education and lived experiences in informal and non-formal settings. Traditional assessment methods often fall short in this regard; hence, the implemented sequences emphasizes experiential learning and reflective tasks over abstract concepts.

By engaging participants through their senses, we aimed to deepen understanding of how they perceive and value educational experiences and how SENSE. impacts EU key policy areas. Our evaluation framework combined 'aesthetic methods'—focused on sensory engagement—with structured methods to capture broader changes in practice.

Here, we present an analysis of data collected through these methods, highlighting the impact of the SENSE. approach to STEAM on enhancing experiential learning and its effects on participants' educational experiences.

3.1 Overview

STEAM Labs are the centre and focus of activity in the SENSE. Project. As stated in the Description of Action:

> *At each stage, the SENSE.STEAM methodology will be implemented as part of in-country STEAM Labs, each one focusing on developing materials and actions and evaluating their impact on each of the four key thematic areas of Digitization, Green Deal, Health and Work Readiness. The Labs operate as hybrid collectives, sharing experiences and deepening impact across EU regions. (DoA Part A, p. 3)*

The period of the “Europe-wide implementation phase” (DoA part B p. 25) of the SENSE. methodology in STEAM Labs began in Summer 2023 and concluded in Summer of 2024 with the intent of “creating real, meaningful impact and to test the applicability of the roadmap. It also benchmarks the methods implementation to allow replication across countries, institutions, cities, and schools and to guarantee networking with other projects. Ultimately, this is the evidence base of SENSE. and the backbone of any dissemination activity involving transferability, documenting the challenges and opportunities.” (ibid p. 25, emphasis added).

During the period of implementation, the SENSE. Consortium has consisted of 10 partners and 6 associated partners. The consortium established 12 STEAM labs in 12

different countries, each hosted and led by a locally-based Consortium institution (see Table 2).

Table 2: SENSE. STEAM Labs during the SENSE. Europe-wide implementation phase

STEAM Lab Country	Participating Consortium Partner(s) and Associated Partner(s)
Estonia	Velvet
France	Louvre Museum
Georgia	WECF Georgia
Germany	University of Education Weingarten (PHW)
Greece	Odyssea
Ireland	Hawkins\Brown
Italy	CREDA Onlus;
Norway	Western Norway University of Applied Sciences (HVL); VilVite
Romania	Group of the European Youth for Change (GEYC) Primăria Municipiului Câmpina
Spain	University of Barcelona; Fundació Bofill
Sweden	Trelleborg
UK	University of Edinburgh (Scotland)

These STEAM Labs carried out 174 activities during this implementation phase. 136 of these activities were designed as a SENSE. learning sequence or as part of a SENSE. learning sequence. Other activities also included dissemination about the SENSE. project, discussions, network and advocacy. According to the reporting collected from partners, there were over 2,200 attendees to learning sequence activities. Some activities were part of multi-day learning sequences or repeated work with a group, so this number is not the number of unique participants in learning sequence activities. However, it indicates the high reach and time spent with participants introducing and implementing the SENSE. educational approach over the course of the roughly year-long implementation phase. For each of the 136 SENSE. learning sequence activities, facilitators of the activity from a partner institution reported on the activity before and after the activity using the activity reporting template. Additionally, 100 activities were further evaluated using one or more of the co-evaluation methods set out in this deliverable.

The co-evaluation data are thus broken down on two axes. The first axis is if the activity was evaluated using an approach that was post-test, pre-post-test, or a pre & post-test with a follow-up at least 2 months later (Table 3). By July 2024, full co-evaluation data with 2 months follow-up was received for 10 activities, findings of which are included in this deliverable. Data received after this time will be integrated into future outputs.

Table 3: Learning Sequences by co-evaluation data collection time

Learning Sequence Co-evaluation	Number of learning sequence activities
Facilitator Activity Reporting only	36
Post-test	36
Pre-post-test	54
Pre-post-test with follow-up 2 months later	10
Total	136

The second axis covers the type of co-evaluation method used (Table 4). By July 2024, full co-evaluation data with SENSE.-aligned sensory portraits was received for a total of 52 activities, findings of which are included in this deliverable. Data received after this time will be integrated into future output.

Table 4: Co-evaluated learning sequences by method

Type of co-evaluation used	No. of learning sequence activities co-evaluated
SENSE.-aligned sensory portraits (sometimes accompanied by additional mapping or other methods)	45
Survey questionnaire	30
Survey and SENSE.-aligned portraits	12
Other (as guided by context)	13
Total	100

3.2 *Portraitures:* putting *SENSE.* to work across the Labs

Analysis of activity reports showed a wide range of exploration of the SENSE. educational approach. As reported in Table 1, the 3-level heuristic and the possibility to implement ready-made or devise new sequences, accounted on the one hand for different understandings of STEAM and on the other hand, for different levels of freedom and range of applicability of SENSE.STEAM principles depending on the local setting, facilitators' professional backgrounds and national curriculum policy. For example, partners VilVite (Norway) and Hawkins\Brown (Ireland) each designed a learning sequence that built upon their strengths (as a science centre and as an architecture firm) of about 1-3 hours in length and implemented this activity in a similar way across 10-12 groups of secondary school students. This organisational approach contrasts with, for example, the STEAM Lab learning sequences run by the University of Edinburgh in Scotland where two researchers worked with three groups: a class of girls in a secondary school located in an underprivileged area in Edinburgh, on the theme of designing, planting and harvesting garden and exploring themes of food; a group of primary school student teachers; and continuing professional

development sessions with teachers over the entire course of the year. Also, while the activities at VilVite and Hawkins/Brown tended to be structured and were replicated over a number of sessions, at Edinburgh, the choice was to remain responsive to students' needs and their evolving level of confidence with being in the garden and actively using their senses to learn about it.
The different timelines cast light on opportunities and constraints and can be used to map areas of potential as well as need. Additionally, in STEAM Lab sharing sessions that ran weekly during the STEAM Lab implementation phase, partners shared their experiences during their own STEAM Labs and learned from the experiences of others, often incorporating and adapting approaches from other contexts. This will be further explored in the evaluation along impact areas. Taking account of such differences, we collated the stories of each Lab in three main *portraitures* (Travis, 2020), which give an insight into how each site approached the implementation within their setting. The writing of the portraiture was structured along a set of common questions (see Figure 7) while opening up to different ways in which the SENSE. approach made a difference in each setting. Specific examples from some of the Labs are given as a means of illustration.

Is there a central theme running across the Labs?
What was the main rationale for the activities chosen and performed?
How far does the relationship between arts and sciences map against the 3 levels?
To what extent are Inclusion/Space/Sense an explicit or an implicit dimension of the STEAM process?

Figure 7: Questions guiding the analytical reading of facilitators' reflective notes across the Labs

3.2.1 *First portraiture*: The Art of Science. Expanding imaginative potential with *making and creating*.

One of the ways in which SENSE.STEAM was approached across the Consortium was through its being an opportunity to connect curriculum content with personal experience and real-life events. For example, VilVite science centre (Norway), HVL and Trelleborg (Norway and Sweden), Velvet (Estonia), Musée du Louvre (France) and Hawkins/Brown architects (UK)while conducting different activities, converged into a rationale for choosing those which enabled participants to engage in hands-on task, based on design, imagine and make, including modelling. Across all labs, the impetus came from the need to address the needs expressed by key stakeholders to

expand on outcomes in the educational curriculum around sciences or the expressive arts. The preferred choice was to use structured, ready-made activities which could be seamlessly integrated within an existing provision; yet all activities engaged with imaginative thinking supported by making with materials, to move from outcome-driven teaching to purposeful and playful interaction with resources and with spaces allowing to produce something new. Across all labs in this group the core message was to challenge assumptions about capabilities or gender destinations and give more attention to making education more relevant to today's needs.

VilVite science centre organised for school classes to visit their premises and designed in collaboration with HVL an activity "Extra-terrestrial life", in which participants imagine the conditions for life on other planets and make physical representations of the life they created there. Over the course of 1-2 hours participants worked together in small groups, negotiating what they believed life would be like based on the physical conditions, and also exploring how they could use the materials they had available to them to make physical representations of that life.

This was an adaptation of the activity "Article for the future" that was available from the original bank of activities but was expanded to include a dimension of making, thus engaging further with the senses by working with 3-D models as well as increasing awareness of how space that allows for a range of movement and personalisation can promote creativity and confidence on themes of future-making skills and visions.

Figure 8: Steaming into the future at VilVite

Hawkins\Brown architects visited schools in England and Ireland and conducted sets of 2–3-hour activities. The main focus was usually a structured exploration of play with light and shadows with the main intention that participants would understand how space plays a role in determining social and cognitive behaviour, along with explorative freedom to go in new directions.
This activity may be used in teaching children about light and shadows in physics or general science, for example by using pinhole camera boxes or modelling and testing lengths and appearance of shadows in different conditions. However, in this context, with architects as facilitators, these activities went in many different directions, while exploring themes of how to explore space *like an architect*, among other disciplinary fields, or one's personal response to what might be a surprise effect.

Figure 9: Hawkins/Brown: surprising light effects

HVL conducted several STEAM lab activities, such as developing a taxonomy of stones, painting with soil, writing an article that comes from the future, or artistic representation of falling leaves and involving groups of newly graduated trainees from various companies in Bergen as well as student teachers and families with children. Characteristically the falling leaves activity and painting with soil are both a scientific experiment showing the curved trajectory of leaves falling from an altitude or the ways in which different soil absorb water and release pigments, but also an artistic one, by producing immediate observations of variation of movement or color and observing with immediacy a natural process in which participants themselves are a part.

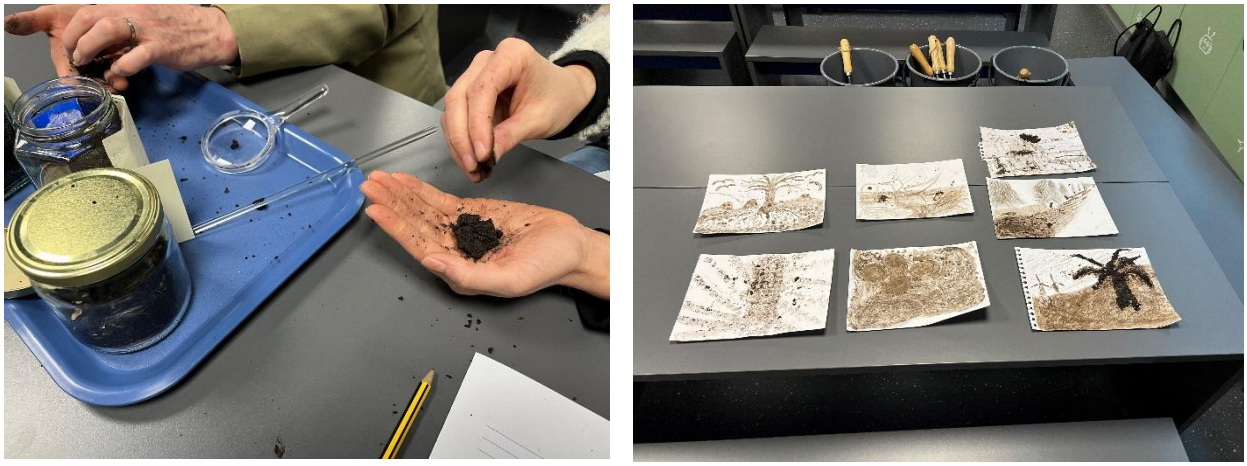


Figure 10: Sensing and classifying soils at HVL

The activities conducted by facilitators from the Musée du Louvre were largely focussed on involving participants in creating and making with materials, such as painting with pigments extracted from plants, building walls using various resources or create light ambiences within own designed models. on involved groups of children. Facilitators worked with groups of primary school children and their teachers using concepts such as light as cross-disciplinary ideas that could connect with different areas of the curriculum (e.g. physics, art) but could also afford the possibility for children to see how these concepts may have relevance for professional architects, designers and visual artists, thus connecting with the world of work. Characteristically, working with materials produced a very different engagement with the space of the classroom and the perception that children had about messiness or dust as being part of the creative process.

Figure 11: Windows of light- Musée du Louvre (left); extracting pigments for watercolour painting (top and bottom right)

3.2.2 *Second portraiture*: Mapping space through design and participation.

A centrally running theme for participants working with Odyssea (Greece), GEYC (Romania), PHW (Germany) and WECF (Georgia) was to give young people space to explore/discuss/re-imagine their own community and how it addresses their needs. SENSE. appears as a means to counteract the discourse of disenchantment with current educational practices and actively re-configuring the way people see themselves as playing an active role in their society. This was done physically and actively through a mapping tool. For example, the activities “building a house for a fairy”, “mapping favourite places”, “the skin of the world” conducted by GEYC with 10 groups of young people across different sites in Romania, acted as a powerful mediator between the political dimension concerned with what spaces are available to youth, and the aesthetic domains, as what spaces may favour social interaction and discussion on matters that affect young people directly in their own communities.

GEYC organised a series of meeting with groups of young people using the reorganised space of a local library. Care was taken to make sure the library spaces were used flexibly with opportunities to move chairs; to use nooks and crannies and cosy areas as well as using the outside space. This approach contrasted starkly with the traditional way of teaching and how classrooms are organised in schools; the mapping activity on favourite places disclosed a variety of experiences and concerns from the young people (for example lack of lighting in the streets and evidence of drug use in public areas), who felt there was a great need to find spaces and opportunities for them to discuss.

Figure 12: GEYC: Making a house for a fairy

WECF in Georgia involved a group of girls attending the STEM club held after school over a period of 10 weeks to engage with a STEAM approach that brought them into contact with the dimension of the senses and their own imagination, as central elements of being a girl in science. Working in a setting with limited resources and often reliant on ready-made kits obtained from or donated by business companies, the WECF Lab introduced the girls to a wide selection of activities and sequences, each time engaging them with different aspects of the STEAM approach: from playful imagination to critical reflection on their own learning and the perception of themselves as 'innovators' in the Georgian society. Interestingly, the new activities offered the chance for the girls to integrate some of the STEM designs and prototypes they had produced prior to becoming involved with the STEAM Lab thus expanding their idea of what it means to work in science while critically reflecting on its role and value in society and the environment. The experiences outdoors were

also new for this group, often not being considered as a space for educational activities: for example it became apparent that making the house for a fairly model might have worked better outside, as they mapped the spaces that were most suited, rather than indoors; similarly, scientific observations of soil could be conducted easily indoors but the experience of making compost outdoors was a new experience that became more relevant to them over time.

Figure 13: WECF - Making a house for a fairy (left); making compost (right)

In a similar way, the choice of activities conducted by Odyssea in Greece while originally spurred on by a work-readiness agenda and largely concerned with the differential opportunities available to boys and girls to engage with science, led to important discussions about the opportunities that exist to challenge stereotypes and assumptions commonly held about young people and their future in society. This shift was enabled by the implementation of participatory activities involving several groups of young people over time that encouraged sensory involvement and responding actively to issues by cutting, remodelling and critically reconfigure messages produced by magazines and social media about gender stereotypes. SENSE. methodologies that encouraged mutual feedback supported a discourse of STEAM as social transformation and conscientization.

ODYSSEA ran 10 sessions with groups of young people using activities involving make and create – such as gender portraits and article from the future – which were designed to engage participants directly, hare and challenge held perceptions and to stimulate imaginative thinking. It became apparent that a certain lack of familiarity with this approach was common and both space and furniture were a critical dimension to be actively considered for this type of pedagogy.

Figure 14: Odyssea: Mapping favourite places (right); gender portraits (left)

In Germany, PHW worked with different groups of students, at University and secondary education level, to introduce them to a form of experiential learning to connect the abstract knowledge of science courses with greater engagement with their own experience of sensing colour and materials and making sense of their own environment. Mapping and drawing were facilitating approaches in this case to draw students out and lead them out to practice with approaches that were more open-ended and allowed for creative and affective responses to places and materials, exchange of perspective and empathy while working with other people and considering other creatures in the environment outdoors.

Figure 15: PHW: Mapping favourite places (left); exploring the tension between making and design (middle); colour pendulum (right)

3.2.3 *Third portraiture*: Actioning knowledge in the real world.

For other three partners, Creda (Italy), UEdin (UK) and UB/Bofill the starting point for the implementation was the desire to contribute to a different kind of science education; one that values and includes a variety of perspectives; engages the senses and the body and focuses on addressing real-world issues, such as food security, heat and climate change in practical, imaginative and experiential ways. In this portraiture the key theme is "acting as if…", that is the drive for turning everyday spaces and activities into artistic actions to enact desired futures. For example, for CREDA (Italy), activities outdoors engaged the senses and led to the amplification of voices that were silent in the classroom but were heard in nature. Activities involving design, and scenography set ups raised awareness of participants' abilities to create and craft something of their own initiative.

CREDA organised a series of events held in different locations – public park, public exhibitions and the local environmental education centre – aiming to involve the wider public, groups of young people but also teachers and business professionals. STEAM comes across as a discourse of opportunity to reclaim agency through imaginative capabilities and re-engage with educational practices that support social interaction and wellbeing to address common concerns around climate change. MAKING with natural materials and PHOTOVOICE act as powerful mediators between the cognitive and sensorial/aesthetic domains. However, there is also a recognition of how

elements of actual co-production may be difficult to implement as they require greater collaboration and a very different use of the spaces available in schools.

Figure 16: CREDA: Sensory mappings

Similarly, for UEdin (UK), two educational researchers worked alongside the class teacher and met with the girls' class over 12 sessions from October 2023 to April 2024 and in this time the participants explored themes of sensing, making through ancient crafts, soil painting, gardening, planning, cooking and sharing with community. Analysis of activity reports show that participants were able to get a very rich experience of the garden as an integral space to their *being educated* at school from participating in the SENSE. educational approach over this long period of time.

The garden space that often sits at the back of the school and it is largely disconnected from curriculum planning offered the girls a place to be and meet themselves as well as other creatures (the mouse that lived secretly under the bushes and delighted itself with the rubbish left behind), a place to move and co-design; and a place to care for themselves and others. And so is the Home Economics base that is not simply training to cook but a space to imagine oneself as a character in a story; a maker of artefacts and a maker of social worlds.

Figure 17: UEdin: From garden to fork... and back

For UB/Bofill engagement in citizen science activities appeared to further accentuate a configuration of STEAM for social inclusion, participation and conscientization of matters that affect communities directly. Embodied perceptions of heat were engaged as a means to reflect on wellbeing an ability to perceive the environment (i.e., the river) differently through a closer contact/direct experience; however, there are questions around how to combine aesthetic/personal observations with data for policy-makers.

Figure 18: UB/Bofill: Citizen science by the river/listening to the river

3.3 Summary of portraitures

Over the course of the implementation, each site operated with a high degree of freedom and flexibility with regards to participants and choice of activity. At times, the same activity was conducted with different age groups and/or repeated and adapted by another Lab from another consortium partner. Yet, based on the needs analysis conducted at the start of the implementation and with consideration of the skillset and expertise of each partner, the implementation surfaced different possibilities in each site and accounted for different types of impacts, as summarised in Table 5 below. Notably, all partners worked both in formal and informal learning environments; yet the intensity of activity varied across the consortium, giving a sense of the flexibility and adaptability of the SENSE.STEAM approach, but also of the different results that may be produced under different conditions.

Table 5: STEAM Labs and associated SENSE. Consortium partners

STEAM Lab Country	Consortium partners	Type of implementation				Level of change
		Pre-designed	Pre- plus own-designed	Multiple groups	Single group over a period of time	
Estonia	Velvet	X		X		Making and Creating
France	Louvre		X	X		Making and Creating
Ireland	H/B	X		X		Making and Creating
Norway +Sweden	HVL-Trelleborg	X	X	X		Making and Creating
Georgia	WECF	X		X	X	Mapping and Transforming
Greece	ODYSSEA	X		X		Mapping and Transforming
Romania	GEYC	X		X		Mapping and Transforming
Germany	PHW	X	X	X		Mapping and Transforming
Italy	CREDA	X	X	X		Enacting change
UK	UEDIN	X	X	X	X	Enacting change
Spain	EB/Bofill		X	X		Enacting change

In the first portraiture, the emphasis was principally about creating awareness about the possibility and the value of knowing differently, by infusing strategies from the world of professional artists (architects; designers; visual artists; performers) into the conventional curricular provision. Results from this group are summarized as follows:

1. Drawing mainly on high-effort singular events, the impact was perceived largely in terms of closing the gap between the world of education, focused on instruction, and the world of work, which is based on resourcefulness, thinking through possibilities, and working towards making something that passed the test of time.
2. The senses in this case were not simply an extra or the privilege of those who engage with the world of the arts, but an accessible and direct way to develop technical as well as imaginative competences, bringing together the maker with the designer and the architect with the electrician, the painter with the ink maker and so on.
3. Space in this portraiture played a significant supporting role for the activities, often being integrated fully into the making process itself through awareness of tri-dimensional effects and movement.

While not all partners worked with disadvantaged groups, the adaptability of the SENSE.STEAM activities significantly overcame institutional elitism, even through one-off events.

In the second portraiture, the emphasis was on creating new opportunities for participants to re-engage them with the world of education and to gain the confidence to play an active role in society. The emphasis was principally on participation, particularly in contexts of high levels of material deprivation and youth disaffection, with key messages as follows:

1. Experiences for partners in this group included many different activities, often singular events but repeated across many participants. This resulted in the opportunity to depart radically from conventional ideas of education, largely indoors, abstract, and static, and stereotyped impressions of STEM education as the domain of the powerful and the masculine.
2. Arts-based methodologies like mapping mediated such a shift, by heightening sensorial and spatial awareness and building participants' reflective consciousness of their role in their local environment; how to pay attention to things that are important for them, and towards which they could direct efforts for change.
3. Issues of safety in the community (i.e. street lighting), availability of food and sense of wellbeing in schools, places to think with others and practice decision-making were important topics which were addressed directly by stakeholders attending the labs.
4. Digitization featured as a skill to support engagement by enabling participants to take the lead in research-creation: for example, in producing graphs (UB; CREDA); make models (GEYC; WECF) and make a portfolio of photographs (UEdin).

While all partners managed to find spaces to undertake the activities, it was clear that the formal educational spaces in schools and Universities were largely at odds with their needs. Hence, both time and spaces for people to meet, feel comfortable and work freely were important considerations, as well as making such times and spaces a legitimate part of their education, for example through reforming schools schedule to free up students in the afternoon to engage with artistic and social activities, or re-inventing the role of civic spaces such as libraries to welcome the activities of the youth.

In the third portraiture, we found the sustained efforts of partners that have been working on issues of environmental change and sustainability for some time. In this case, activities that were offered targeted key issues such as health, poverty, wellbeing; and engaged participants directly through experiential, arts-based methodologies as well as scientific research to impact public perception, redirect policy priorities and liaise with the world of teaching both through schools and teacher preparation. Results point to action, and re summarized as follows:

1. Experiences for partners in this group tended to be largely outdoors, either in public spaces or in formal and informal education contexts with the clear intention to connect the senses with the local reality;
2. Similarly to the second portraiture, emphasis was placed on building participants' reflective consciousness of their role in their local environment, but in this case the effort went further, as participants introduced changes in the outlook of their environment, either through direct actions such as gardening and data collection and analysis of data to share in public settings, or symbolic enactments of problematic situations that were offered for discussion.
3. Key to all the activities was a long-standing effort to go beyond the privilege associated with formal institutions like the academy, and engage with local municipalities on the ground, build relationships of trust with participants, with teachers as well as children and their parents, and work closely with marginalized groups in society.

Many lessons learnt from partners were incorporated in this portraiture, for example with regards to access public spaces and make time for shared experiences in ways that may help to bring different actors in society to speak to each other and work towards addressing the shared needs of a community.

Overall, the results from the three portraitures provide evidence for implementation of the three key stages of the Roadmap: Advocacy; Awareness and Action which will be further detailed in D 7.3 (Learning Companion) and D 4.4 (Recommendations for the Roadmap).

3.4 SENSE. impact on individual participation

Of the 136 SENSE. learning sequence activities as part of the STEAM Lab Europe-wide implementation phase, 57 of them were co-evaluated using the evaluative approach detailed in section 3 as the SENSE.-aligned co-evaluation approach with sensory portraits (see Table 6 below). By July 2024 we had full co-evaluation data with SENSE.-aligned sensory portraits was received for a total of 52 activities, findings of which are included in this deliverable. Data received after this time will be integrated into future outputs.

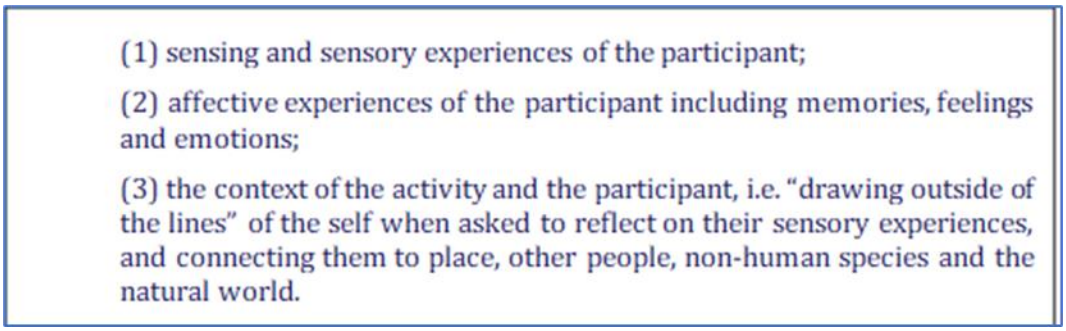
Table 6: Number of learning sequence activities with sensory portrait co-evaluation

SENSE. Partner	No. of learning sequence activities with SENSE.-aligned sensory portraits received and integrated in analysis in this report
CREDA	2
GEYC	8
H\B	9
HVL	7
ODY	6
PHW	3
UEdin	2
Velvet	1
VilVite	11
WECF	3
Total	52

The intent of the sensory portraits as co-evaluation of the impacts of the SENSE. educational approaches are described in section 3. The analysis of these portraits took place starting as continuous monitoring of the progress of STEAM Labs in March of 2024 and continued until July 2024.
A total of 619 sensory portraits (number as of checking 25 July) from across these 52 activities were received and analysed using a qualitative coding scheme developed by a qualitative coding team established by the three co-leads of the co-evaluation task in WP4, with experience in qualitative data analysis and with the SENSE. educational approach. As a team, we developed a first set of codes which was reviewed through a series of iterations until we achieved a set of codes that captured the central structural elements across the datasets (saturation). The codes were then shared with the full consortium during the (GA meeting in Tbilisi) and as part of the interim analysis of the STEAM labs at the Friday's meetings (sharing labs).

The first phase of coding consisted of an exploratory abductive coding based upon the intentions of the co-evaluation measure, becoming familiar with activity reports of activities, open coding of a selection of portraits, internal discussions between the

coding team and discussions between the coding team and the SENSE. consortium through regular STEAM Lab sharing sessions.
Through this process, the coding team created a scheme of closed codes based around interpreting the sensory portraits around three major themes as emerging before and after the activity (Table 7). For a full description of the coding used in this phase see Appendix 5 and 6.


(1) sensing and sensory experiences of the participant;

(2) affective experiences of the participant including memories, feelings and emotions;

(3) the context of the activity and the participant, i.e. "drawing outside of the lines" of the self when asked to reflect on their sensory experiences, and connecting them to place, other people, non-human species and the natural world.

Figure 19: Coding analysis of the portraits

This qualitative coding scheme was formalised and presented and discussed with the consortium, including at the Spring 2024 project meeting in Bucharest, Romania in April 2024. Shortly afterwards, the coding team confirmed the closed codes and in the second phase of coding analysed all the sensory portraits using this coding scheme.

Analysis from the second phase of coding showed a rich dataset to draw upon for description and describing the impacts observed in this evaluation measure. Three general findings across all activities evaluated using portrait activities are briefly described below.

3.4.1 First finding: SENSE. activates sensory awareness and sensory experiences.

The activation of learners' senses is a foundational part of the SENSE. educational approach. As stated in the SENSE. Methodology Deliverable 3.5 (emphasis added):

> *SENSE. is grounded into a consolidated methodology for stakeholders' engagement, from mapping needs to co-creation, which builds upon a renovated conception of cognition beyond abstract thinking, to include the sensing body as an extended modality of knowing across time and space. (p.17)*
>
> *SENSE as future-making, emphasises the potentiality of the sensing body as the prime locus of cognition, bringing together abstract conceptualisations, that are static and bounded with aesthetic thinking, that is dynamic and contingent. This capacity engages the full range of sensorial capacities of the*

body, yet it precedes the elaboration of artistic or scientific products, instead shifting its emphasis. (p. 20)

Coding analysis included noting when participants indicated in their sensory portraits a change or expansion of sensory experiences from before the activity to after the activity. Majority of participants in 71% of the pre-post activities indicated an expansion or change of sensory experiences from before the activity to after the activity. There were also very few activities (13%) where few participants explicitly indicated this expansion or change.
Activating participants' senses and sensory engagement in the learning process was one of the central aims of the design process of SENSE. learning sequences, and the evaluation portraits provide a rich dataset of ways that participants have expressed this activation of sensory experiences.

Figures 19 through 29 provide examples of participant expressions of a change in sensory experiences and expansion of sensory experiences after SENSE. learning sequence activities. These expressions come in many forms, and are also informed by the type and focus of the activity that participants took part in. The example portraits also portray some overarching themes of activation of senses found in multiple portraits. These themes include:

A change or expansion of sensory experiences expressed in the hands and feet including connecting those experiences to roots into the ground (figure 20).

Figure 20: CREDA 01 LS Before – Blue; After - Black Change in senses in the feet, perception of heat, burning or flames but also as a root

Sensing there where it had not been indicated before as a focus of attention, indicating an exploration of sensory experiences and imagery resulting from it (Figure 21, from Hawkins/Brown working on light).

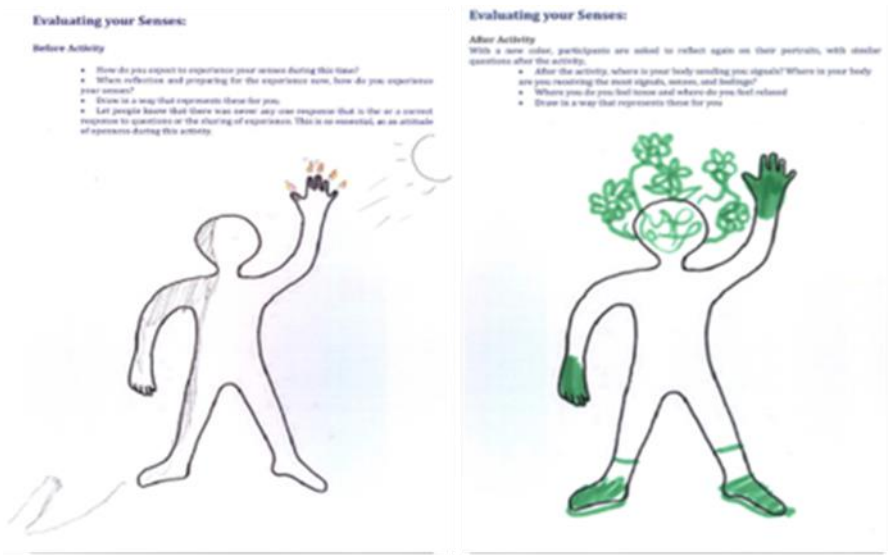


Figure 21: H/B Sensory portraits. Left: Before; Right: After. Expansion of sensory experience in hands and feet as well as development of imagery through flowers and plants (right)

… and in other cases, the sensorial exploration brought out a change in the way participants became aware of themselves and connected such awareness to their senses (figure 22, figure 23-24).

Figure 22: PHW 14 LS Expansion of sensory experiences expressed with eyes, nose hands and arms

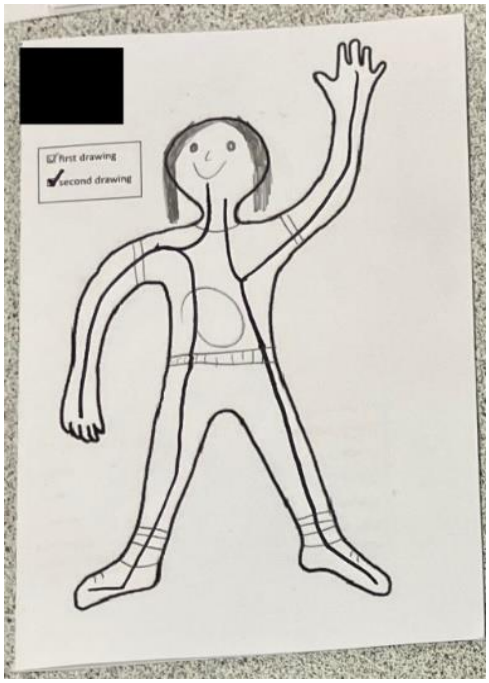


Figure 23: UEdin 03 LS Before - Grey; After - Black. Expansion of senses across the body, as well as connection between sensory experiences of arms, legs, torso to neck and head.

Figure 24: UEdin 03 Before – Black; After – Green
Expansion of sensory experiences in hands, feet and stomach, as well as a change from presentation of self in context (clothes, shoes, hair) to a focus on sensory experiences.

A change or expansion to sensing was also expressed via integrated sensing of multiple body parts, such as drawing lines about sensory experience between, around and connecting body parts, but also an expansion of senses beyond the body, 'drawing outside the line' of a clear drawn demarcation of self v. not-self (figures 25, 26, 27).

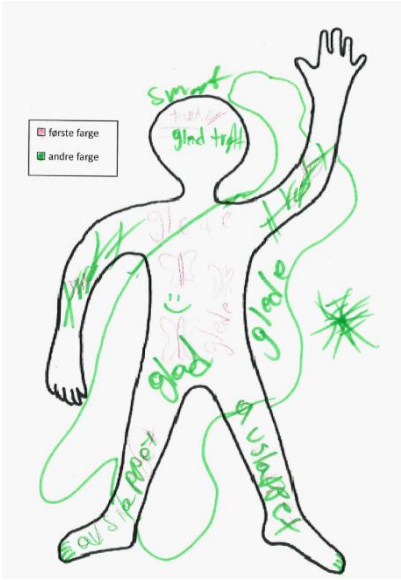


Figure 25: VilVite 01 LE LS Before – Pink; After: Green Change in feet, arms, connections between sensory experiences. Words additionally describe affect (smart, happy, relaxed)

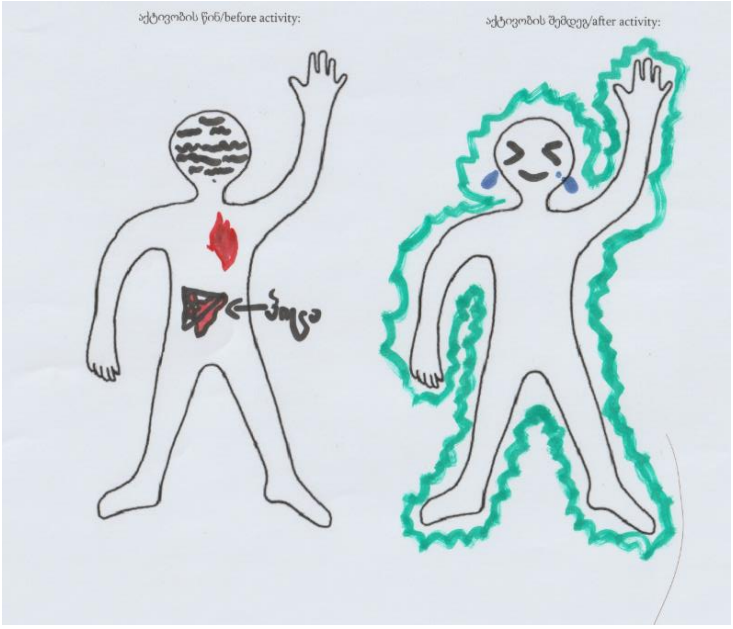


Figure 26: WECF 09 LS; Before – Left; After – Right. Change in perception and sensing of skin or border of body and the outside world

Figure 27: VilVite 10 LS. Before – Red; After – Blue. Whole body expansion of senses and additional connection of sensory experience to around and outside body

A change or expansion from other conceptions of self (related to identity, how they are perceived, their capabilities, dreams and ambitions) to connecting those conceptions to sensory experiences. For example, making connections of sensory experiences after drawing a portrait of a self with wings or a with a cape (figures 28 and 29).

Figure 28: GEYC 06 LS. Before - Red; After - Blue. Change in sensing generally, in addition to change in expression of self and affect

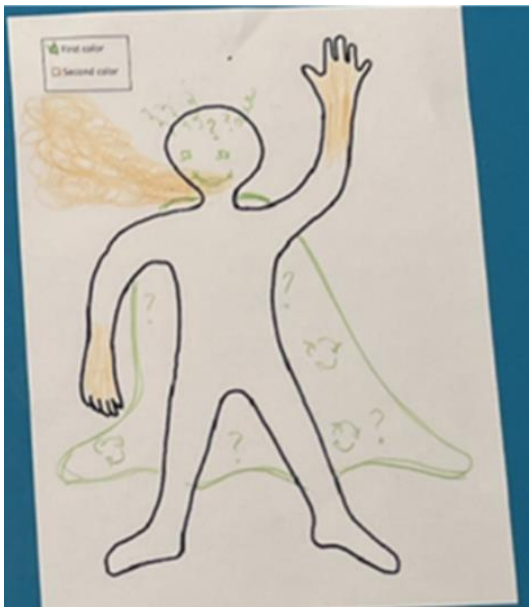


Figure 29: HVL 10 LS. Before - Green; After - Orange. Change in hands and in connection to mouth and air

These example portraits show the richness of how participants portrayed these sensory experiences. There are many ways to continue analysis of portraits in this manner, and the following sections describe directions analysis has continued.

3.4.2 Second Finding: SENSE. allows learners to express emotions and connect with meaning

More than half of the participants in 52% of the STEAM Lab pre- and post-assessed activities expressed an affect or emotion in the sensory portraits in response to the prompt about sensory experiences after the activity. Sensory portraits were interpreted in this way if participants drew emotional symbols, expressed affect through the intensity of the drawing, in written words, or if the portraits were otherwise interpreted by the coder as implicitly addressing affect or emotion. In only three activities did fewer than 1 in 10 participants indicate a connection to the context.

In addition, a majority of participants in 21% of activities (11 out of 52) expressed a connection to context in response to the prompt. This included portraits that indicated a connection to place, nature and other species, other people, or ideas about how they were perceived by others. In only 4 activities were fewer than 1 in 10 participants indicating a connection to context.

The findings in these themes indicate the primary and secondary themes of the learning sequence activities. While not as dominant in the sensory portraits across activities as the pattern of sense activation, these themes are present in the portraits across activities. Connections to context show the impact on four key policy areas. Further information on the coding can be found in annexes five and six.

Connections to context show the impact on four policy areas.

Figure 31: GEYC 06 LS. Before – Red; After - Blue

Figure 30: GEYC 06 LS. Before – Red; After - Blue

The images on the previous page (30 and 31) show the combined impact on both environmental education and health. Shows connection with nature and positive emotions, e.g. facial expressions and symbols such as hearts.

Figure 32: HB 05 Before - (Blank); After - Black

The portrait above (Figure 31) shows a context to health because the student is constantly aware of primary needs, feels hungry or cold, and is able to express their self-awareness and show how it has developed over time.

Figure 34: CREDA 01 LS. Before – Black; After - Blue

Figure 33: CREDA 01 LS Before – Black; After - Blue

Images above (33 and 34) shows before and after. Student shows tied up mouth, heavy weight on their hands, holistic sense of belonging but detached from the person. After participating in the STEAM Lab the person shows positive emotions and connectedness to the environment.

Figure 35: ODY 07. Before - Left; After - Right

Sense. brings STEM into the personal lives of the participants. Participants in this activity (Figure 35) actively worked with gender stereotypes and discussed what scientists look like, their biography, where they work and what it means to be a scientist. Here the participant connected discussion around STEM issues to their personal environment. In addition, the participant changed the experience of their portrait after the STEAM Lab activity. They completely reworked the appearance of a scientist, indicating a reinterpretation of the biography of a scientist, using bold colours and bold lines to show confidence and affirmation of their own ideas.

Figure 36: PHW. Mapping favourite places. Left- Before. Right – After

PHW portrait from the activity “Mapping favourite places” (Figure 36) shows a change from the initial state of being ‘locked in the head’ with physics mental models to a post-state where models have been replaced with ideas (light bulb) resulting from walking to make sense of the reality in the community (use of sensory data).

Figure 38: WECF 10 LS Before – Left; After - Right

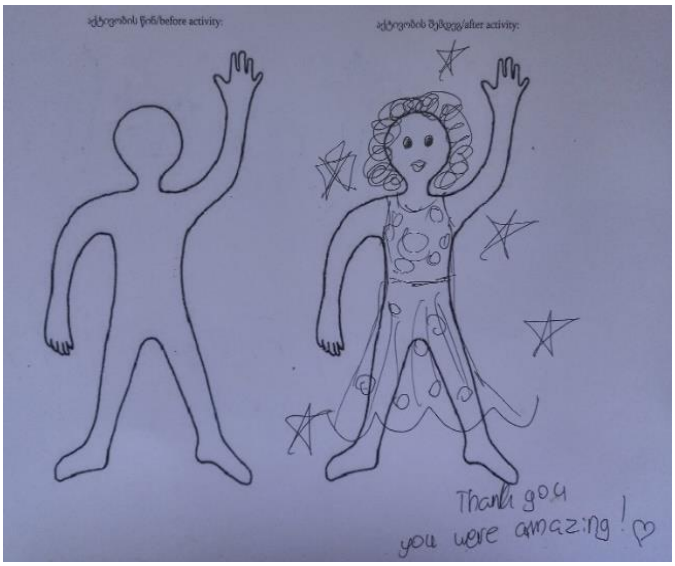


Figure 37: WECF 10 LS. Before – Left; After - Right

Images above (Figure 37 and 38) express positive facial expressions as well as gratitude which supports the impact of the activities on a group of mainly girls. SENSE promotes interest in STEM and provides entry points for female identification with STEM subjects. We will return to these codes in Section 4.5 to provide evidence of impact across the four EU policy areas.

3.4.3 Third finding: SENSE. methodology sheds light on the otherwise not known

Research has established that learning is impeded when learners do not have their primary needs met, including food, rest and sleep, and housing. Educational approaches should try to identify and address this impedance on education.

The second phase of coding of the sensory portraits identified that participants often shared their sensory and affective experiences of their primary needs, in both before and after portraits with participants sometimes indicated that they were hungry, tired or cold. Participants did not usually express when their primary needs were met, indicating that they then moved on to the educational approach.

The SENSE. educational approach as set forth so far does not explicitly speak to addressing primary needs of students. However, integrated into the methodology are approaches such as assessment of learners' needs with the needs assessment and exploring the natural world including food. It is clear that one aspect of the SENSE. approach is that the phases of reflective feedback, especially the needs assessments and the reflection and expression of sensory experiences in, among other parts, the

sensory portraits, brings awareness and attention to these primary needs in the classroom.

Some STEAM Labs identified this need during their STEAM Lab activities. For example, the WECF activities in Georgia, held mostly in the afternoon, were preceded by a short meal, after organisers noticed that participants were often hungry before activities began. The evaluation portraits from these activities do not have the same indication of hungry participants. Other STEAM Labs ran activities centred on the experiences and relationships to food. For example University of Edinburgh's gardening workshops often had tasting food as part of their learning components.

The evaluative sensory portraits make clear that attention to primary needs is an important aspect of the SENSE. educational approach, and facilitators should be made aware of this aspect of the approach. Some SENSE. activities brought these needs to the fore but did not openly address them, which may be a recommendation or development for the SENSE. educational approach going forward.

3.5 Questionnaire surveys

Evaluating the success of the SENSE. project in the areas of sustainability education, health education, digital literacy, and work readiness requires a comprehensive understanding of its impact on participants' well-being, interest, and boredom. By examining these areas through these lenses, we gain a rich, multi-dimensional insight into the project's overall impact and applicability.

In addition to qualitative assessments, which have provided in-depth insights into participants' experiences, the inclusion of this quantitative survey adds a valuable component to our evaluation. Enhancing participants' well-being is crucial as it ensures that educational experiences remain supportive and enriching. Similarly, cultivating interest sustains engagement and deepens learning, while minimizing boredom is essential to prevent disengagement and dropout. Together, these multiple forms of assessment form a robust evaluative framework that guides the development and refinement of SENSE. activities, ensuring they are both meaningful and positively received by participants. This holistic approach allows us to create more impactful and resonant educational experiences.

Well-being is a multifaceted construct that encompasses physical, mental, and social health. In the context of the SENSE. project, improving well-being means that the content provided is not only engaging, but also supports the holistic health of participants. For example, health education elements within the SENSE. project that successfully integrate physical activities, mental health workshops and social interaction platforms can significantly enhance students' overall well-being. Similarly, SENSE. activities that focus on digital skills and equip students with the necessary digital literacy and cybersecurity awareness contribute to their

psychological comfort and social connectedness in an increasingly digital world. In addition, SENSE. Labs that promote environmentally friendly practices and community involvement can enhance emotional well-being by fostering a sense of purpose and connection to broader societal goals. The work readiness components of the SENSE. project, which build confidence and competence through practical and soft skills training, also contribute to a participant's overall psychological and emotional well-being.

Interest on the other hand, refers to the level of engagement and enthusiasm that participants have for the learning content. High levels of interest are crucial as they correlate with increased motivation, persistent effort and better learning outcomes. Components of the SENSE. project designed to improve employability that include interactive elements such as role-playing, real-life problem-solving and collaborative projects are likely to engage students more effectively than traditional lecture-based approaches. Similarly, digital literacy activities within the SENSE. Labs that involve hands-on experience with contemporary technologies and real-world applications can significantly increase participants' interest by making the learning process more relevant and engaging. Health education activities that include interactive elements, such as self-assessment tools, fitness challenges and mental health apps, can keep students interested by providing immediate, tangible benefits. Sustainability education initiatives within the SENSE. project, which include projects such as community gardens, recycling initiatives and energy saving competitions, can also engage students by linking learning to real-world environmental impacts.

Conversely, boredom is a critical measure of disengagement and lack of enthusiasm, which can severely hamper learning. SENSE. activities that fail to stimulate interest and instead induce boredom often struggle with high dropout rates and low knowledge retention. For example, digital literacy initiatives within the SENSE. project that does not adequately integrate interactive or practical components can bore participants and reduce the overall effectiveness of the training. Work-readiness activities that rely too heavily on theoretical instruction without real-life application may fail to hold participants' attention, rendering the programme ineffective. Similarly, sustainability education initiatives that do not actively involve students in hands-on activities can lead to a loss of interest and engagement. Health education activities that are overly didactic and lack interactive or participatory elements can also lead to decreased enthusiasm and increased dropout rates.

In this section, we present data illustrating the positive impact of the SENSE. approach on participants' well-being, interest, and boredom. Our comprehensive analysis evaluates the project's impact across different age groups, genders, and European countries, demonstrating that SENSE. successfully addresses the educational continuum, engages the general public, and appreciates cultural differences.

By examining these three key categories through various demographic lenses, we highlight the broad reach and inclusivity of SENSE. activities. The data reveals significant positive impacts on participants' holistic development and engagement, affirming the project's success in creating enriching educational experiences. Whether young or old, male, or female, participants in different European countries benefit from the holistic and engaging activities offered by the SENSE. approach to STEAM education.

Reliability tests according to McDonald Omega show high validity of the scales, with 0,84 for “Interest”, 0,90 for “Well-being” and 0,81 for “boredom”. Overall, 172 participants (57 % female, 43 % male) in 19 different STEAM Labs contributed to the survey. Participants covered all age spans.

Table 7: Distribution of age among participants

Age	Percentage
0-12 years	13
13-18 years	47
19-25	16
26-65	9
Above 65	1
26 particpants did not indicate their age	

The overall results proof success of the SENSE. educational approach and the implementation work done by the STEAM Labs. We can also see that our programme is very attractive and equally attractive to men and women and all age groups. See below the tables showing the overall percentage scores on Interest, Wellbeing and boredom scales and the scoring with respect to gender and age.

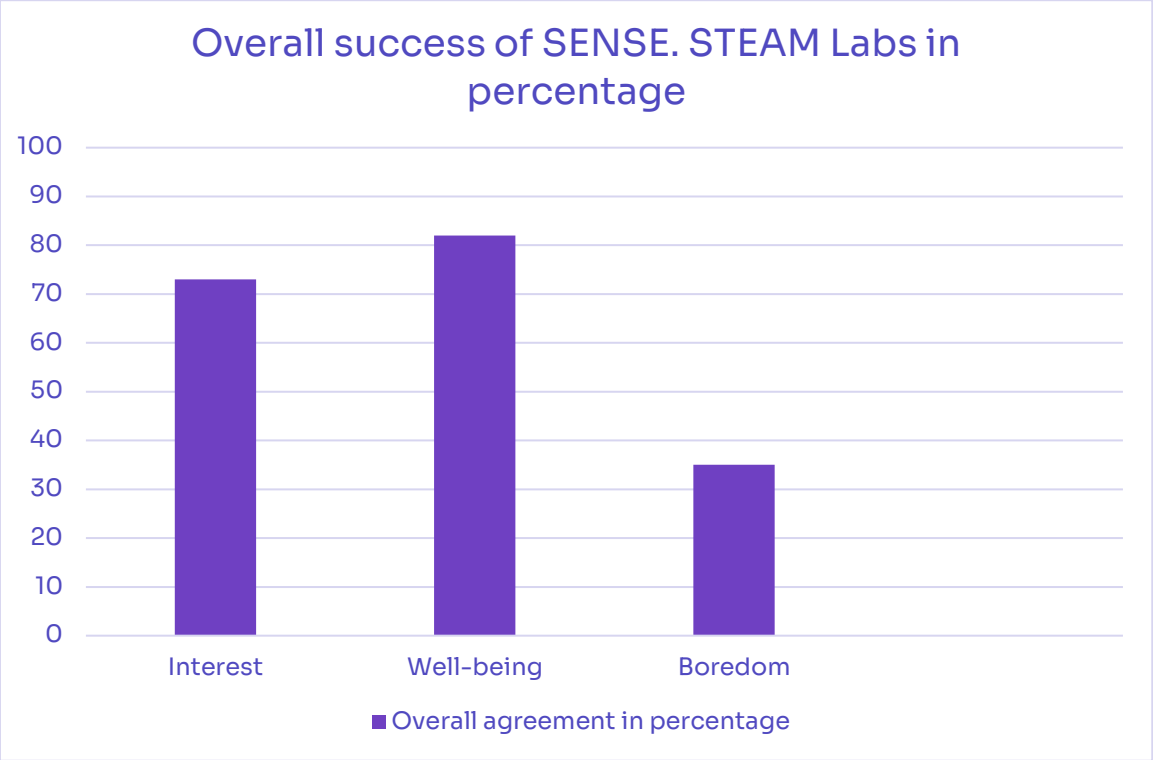


Figure 39: Overall success of the implementation activities showing high scores for interest and well-being while feeling of boredom was low.

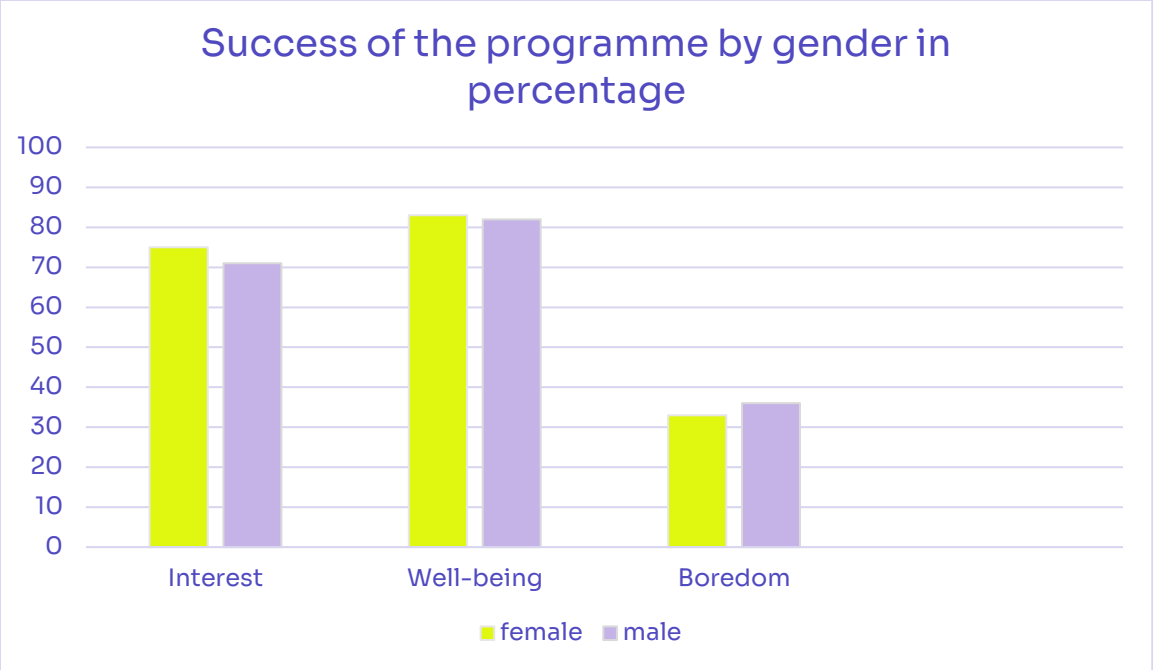


Figure 40: Appreciation of the SENSE. Lab activities by gender. It is noteworthy that reported interest and well-being of females was as high as of male participants

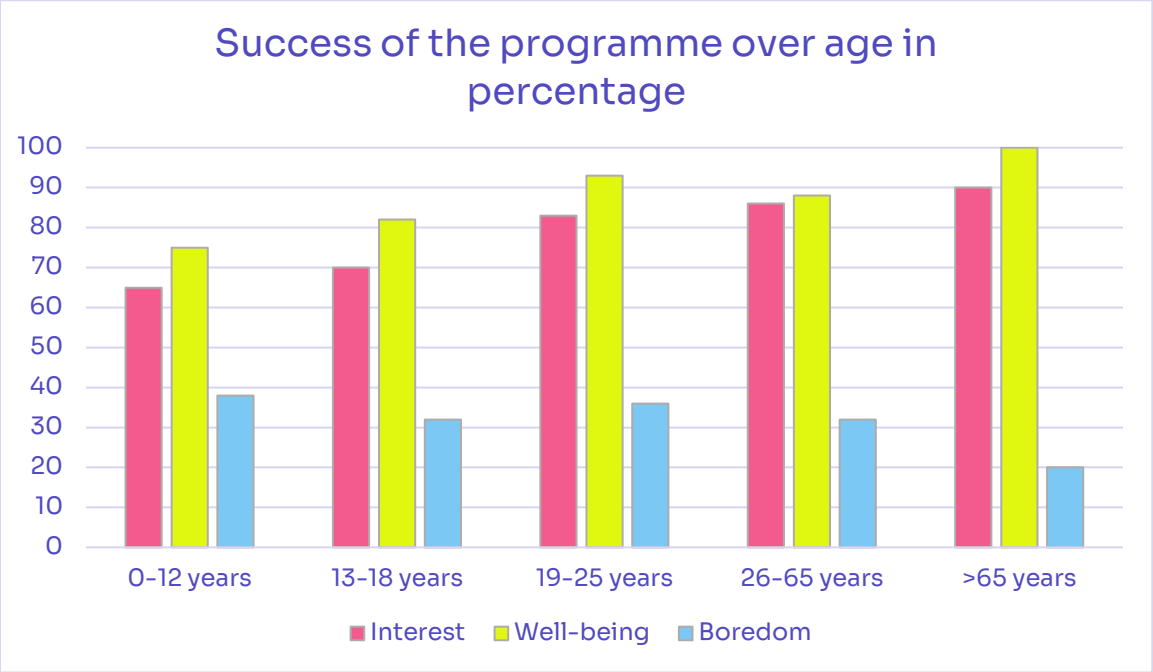


Figure 41: Data showing the success of the programme across all ages

We also see that the positive resonance is continuous over the different STEAM Labs across different countries having worked with very different types of groups from higher education students to young people having dropped out from education programs (Figure 42).

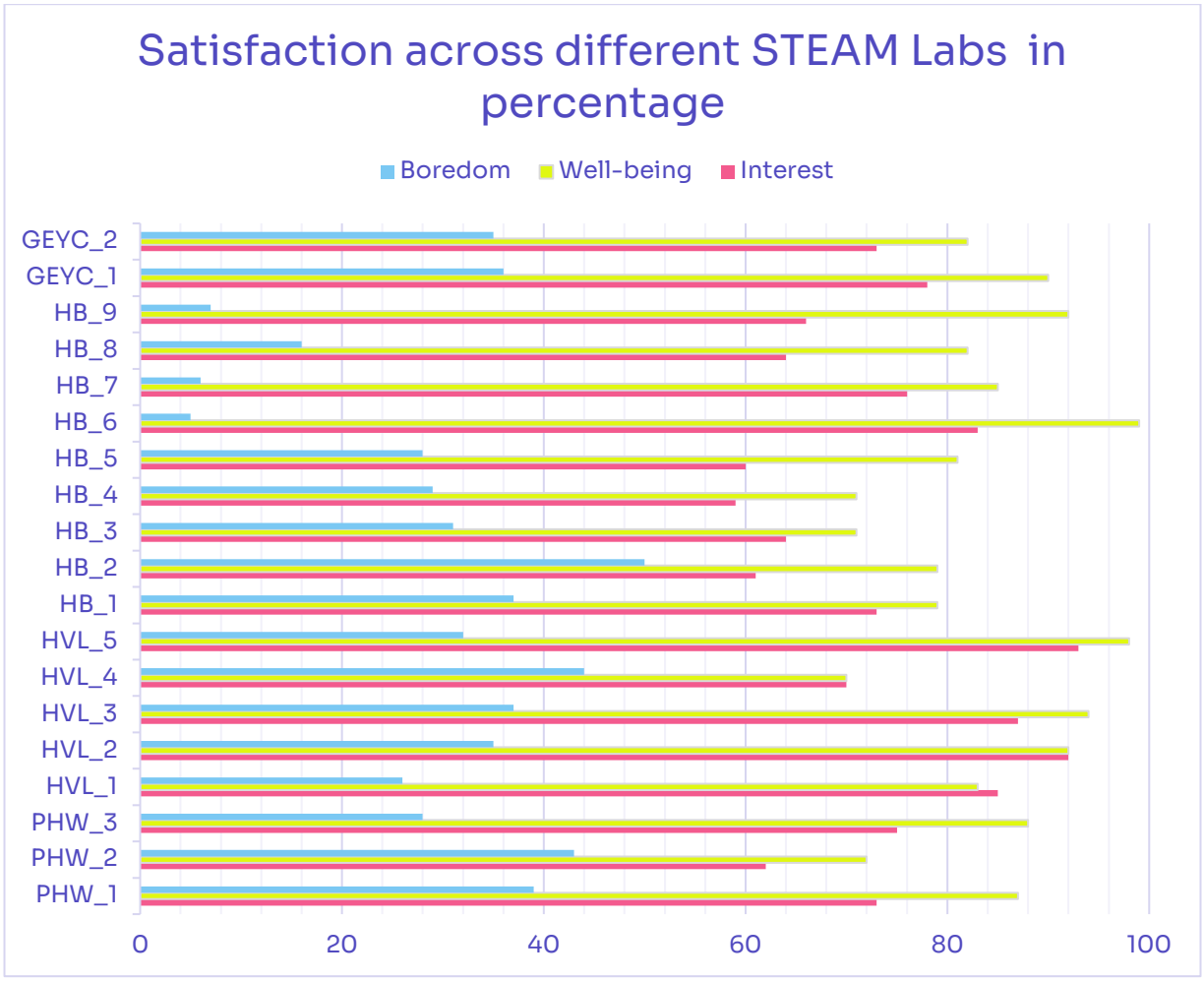


Figure 42: Survey results from STEAM Labs in Germany (PHW), Norway (HVL), Ireland (HB) and Romania

In conclusion, assessing the impact of the SENSE. project in sustainability education, health education, digital skills, and work readiness through the lenses of well-being, interest, and boredom provides a rich, multidimensional understanding of its effectiveness. Enhancing participant well-being ensures that educational experiences are supportive and enriching, capturing interest helps sustain engagement and deepen learning, and minimizing boredom is essential to prevent disengagement and dropout. Together, these measures offer a comprehensive evaluative framework that can guide the development and refinement of the SENSE. activities, ensuring they are both impactful and positively received by participants.

4. Impact in targeted areas for STEAM education

The contributions of the SENSE. project aligns with demonstrating impact on several key European policy priority areas: the Green Deal aimed at educating towards a sustainable future, health and well-being, work-readiness, and digitisation.
SENSE. addresses the topic outlined in the HORIZON-WIDERA-2021-ERA-01-70 call and specifically targets its priority areas, making an impact across multiple levels and sectors within the European Research Area (ERA). Additionally, the implementation focuses on increasing interest and participation in STEAM disciplines.

4.1 Impact on interest and participation in STEAM

One of the key impact priorities of the SENSE. project is to promote a science-literate society and increase the number of scientists in Europe by encouraging and raising interest in STEAM across all age groups. The survey results presented in section 3 show that SENSE. appeals to participants of all ages and encourages interest in STEAM, but also aims to increase female participation and reduce gender stereotypes, e.g. through gender portraits.
Evidence from both the portraits and the questionnaire results shows that by integrating participatory arts approaches into STEM, the project harnesses creative thinking and applied arts to make science more accessible and engaging.
In addition, SENSE. has developed strategies that increase the potential uptake of science careers and provide opportunities for women to be identified, thus strengthening the talent pipeline, and showcasing the diverse opportunities within the field. In particular, the successful examples of H\B and PHW.
We can already see the positive impact of SENSE. through its implementation and evaluation, demonstrating its effectiveness and potential for long-term success. An overwhelming number of portraits show positive emotions, either through facial expressions or symbols such as hearts. The notable changes in the pre-post evaluation are presented in section 3. As the impact targets are a matter for the project, the consortium is tracking them as it works with 100 early adopters in the final phase.

4.2 Aligning Education with Societal and Industrial Needs

The SENSE. project has demonstrated significant success in aligning education with European policy priorities: the Green Deal, health and well-being, work-readiness and digitisation. Our results show a consistent positive interest across gender and age groups, as evidenced by the SENSE portraits and questionnaires. This reflects the flexibility of the methodology and its ability to harness students' creative thinking, allowing them to personalise STEM education to their own contexts and needs.

In particular, SENSE. has excelled in aligning with the values of the Green Deal, raising awareness of sustainability issues and empowering participants to tackle environmental issues with confidence. In the area of health and well-being, the project's emphasis on sensory engagement has contributed to a deeper understanding and appreciation of these issues. By focusing on employability, SENSE. has successfully integrated industry needs into education, developing students' employability skills and supporting their future career paths. It has also addressed digitalisation by equipping participants with essential digital skills, preparing them for an increasingly digital world.

4.3 Mapping progress on EU policy AREAS

An important impact of the SENSE. project is to drive progress on key European policies such as the work-readiness, green deal, digitization and health and the opportunities they offer for rethinking the work and mission of educational systems in Europe. The portraitures provide sustained evidence of change. Impact is visualised in Table 8 as follows.
As indicated in the DoA, for Digitisation we rely on the European initiatives such as DigComp, the European Union's Digital Competence Framework for citizens and educators, as well as the European Training Foundation's SELFIE tool for work-based learning which is currently being piloted in selected European countries.
For Health, we rely on the European-wide mapping carried out by our associated partner SHE to assess the implementation of school health promotion and the formal Health Promoting School approach in schools in the SHE member countries.
In relation to the European Green Deal, we follow the ongoing work of the European Commission to establish a European competence framework on education for climate change and sustainable development.
For work-readiness, we make use of the ECSO classification (European Skills, Competences, Qualifications and Occupations) and relevant reports such as OECD's report on governance of skills systems.

Due to the highly diverse populations and contexts within the Consortium, the measure of impact was calculated using a measure of Internal or transformational validity (Cho and Trent, 2006), with the following methodological assumptions:

- Based on geographical spread, equating the full consortium to the EU universe;
- Based on the transformational nature of the project, assign the start of the implementation phase to ground zero;
- Validity is the extent to which the methods trigger a change of status quo. Hence,m we measured the differential impact of a common pool of newly designed activities across ground zero and we assessed transformational progress that was reflective of the different economics and cultural systems.

This type of transformational or catalytic validity is articulated in detail by Cho and Trent (2006).

In order to do this, we monitored and recorded all sequences and activities that each Lab conducted over the period of implementation and the total number of participants. We then calculated the percentage of impact by looking at which activities related to which EU policy areas enabled progress in particular settings (the specific number for each Lab is given in Appendix 7).

Table 8 shows in columns 1 and 2 the EU policy areas and some representative features; then drawing upon the analysis of the needs assessments for each STEAM Lab (as presented in the portraitures in section 3.2), Column 3 indicates the Labs which addressed explicit EU policy areas. Columns 3 and 4 provide the percentage of impact.

Table 8: Progress across the 4 EU policy areas

	Example Description	Who?	How far? How many activities ?	How many stakeholders are involved?	% of Impact across the Consortium
Green deal	"From farm to fork" "EU Climate transition Preserving ecosystems and biodiversity	UEdin Creda UB/Bofill	67	1667	27.46% of all [244] activities 38.75% of all [4302] stakeholders
Work-readiness	Creativity Initiative Decision-Making Problem-solving	All Labs incl HVL	244	4302	100% of all [244] activities 100% of all [4302] stakeholders

Digitization	Information and Data literacy Communication Digital content creation	UB; UEdin; ODY; Velvet; PHW; WECF	120	1982	49.18% of all [244] activities 46.07% of all [4302] stakeholders
Health	Healthy school policies School social environment School physical environment	UEdin; GEYC; ODY;	65	768	26.64% of all [244] activities 17.85% of all [4302 stakeholders

100% Work-Readiness. From the Table we see that of the four areas identified, work-readiness was addressed by all Labs with 100% impact, as the methodology was designed at the outset to move out of teaching of abstract models and to develop dimensions of learning which are more closely aligned with the vocational priorities of the world of work. For example, confidence, creativity, positive outlook and meaningful connections to other people and place were clearly evidenced in the body portraits and corroborated by the questionnaire results, and these correspond to the transversal skills endorsed by the ECSO classification (i.e. maintaining a positive attitude; willingness to learn; thinking creatively and innovatively).

50% Digitisation. SENSE. Activities targeted half of the total population through digitisation which ranged from collecting and analysing data but also adopting arts-based methods for visualisation and making sense of data distribution, often also using digital tools. Considering that the digital divide across Europe, this result shows the applicability of SENSE. As a first step for awareness and advocacy in relation to Digitisation.

54% Green Deal and Health. SENSE. Activities explicitly targeted Green Deal (27%) and this corresponded to 40% of total participants with similar results also for Health which counts as 27% for all activities and 18% of the total stakeholders.

The findings are differentiated across the four areas reflecting on the one hand the different needs, resources, and priorities for each Lab. On the other hand, these results are also interconnected. For example, in the Croniques de la Calor activities implemented at the University of Barcelona STEAM Lab, digitisation significantly enhances participants' digital competences through interactive and experiential learning, which is closely aligned with the objectives of Green Deal and Health. These activities involve designing routes in different neighborhoods and walking with participants using sensors to measure temperature. By using devices such as iPads,

the digital tools were easily available – in urban areas in Spain - and ensured that information could be accessed in different formats. This process seamlessly integrated digital technologies and develops key skills among the participants. But also, during the walks, adaptations such as providing visual and auditory cues made the activities inclusive for participants with different abilities, ensuring that everyone benefited from the digital resources while also focusing on other aspects such as health of communities and the environment. This process involved mental mapping, physical mapping and sensory experiences; it involved participants in actively contributing to data collection and analysis and empowered them to take an active role in shaping the project and increasing their digital literacy.

The consortium is now preparing to run similar activities in other STEAM Labs including systematic impact assessment.

5. Conclusion and Recommendations

The previous sections have outlined the evaluation of the SENSE. approach to STEAM education. Using a rigorous and pluralistic methodology, we have sought to assess the impact and effectiveness of the SENSE. programme from multiple perspectives. The following conclusions and recommendations have been drawn:

5.1 Conclusions from the evaluation

We draw the following conclusions from the chosen approach towards evaluation:

- The pluralistic evaluation methodology works and shows to be an appropriate approach to assessing the SENSE. educational approach to STEAM
- SENSE. approach speaks to female participants
- SENSE. speaks to all ages equally
- SENSE. reduces boredom in STEAM learning experiences
- SENSE. generates awareness of key policy areas in particular, with 100% work readiness combined with awareness of environmental issues.
- SENSE. provides practical strategies to sustain engagement such as working in partnerships with employers
- SENSE. provides diversified suggestions for science education beyond the classroom to enhance inclusion in different groups
- SENSE. I socially just because it proved to be applicable in different countries and contexts

- SENSE. can be aligned with national school curricula, addressing topics such as optics and sound, handling of scientific instruments and data, technological design, biodiversity and climate
- SENSE. addresses the learning continuum as it has been successfully implemented by schools, higher education, vet education and informal education such as museums and science centers

5.2 Recommendations for the roadmap development and further implementation

AWARENESS

- The partnership between world of work and world of schools through SENSE.STEAM showed the importance of Space playing a significant role for learning; not simply in terms of infrastructure but most crucially as an element that is fully integrated into the making process itself.
- Space promoted tri-dimensional thinking (important for work readiness) and movement (important for health and green deal). This finding contributes to greater understandings of space in education and how SENSE.STEAM widens the range of opportunities for all stakeholders to learn beyond the classroom.
- The variety of stakeholders involved evidenced the adaptability of the SENSE.STEAM approach, and how it significantly overcomes institutional elitism, even though one-off events.
- The evidence from the visual data (body portraits) showed that the senses were not seen as an extra, or the privilege of those who engage with the world of the arts, but it proved to be an accessible way to develop technical as well as imaginative competences, thus closing the gap between schools and the world of work, as well as between the academic and the vocational.

ADVOCACY

- For many partners, the activities proved effective to re-engage participants with the world of education and to gain the confidence to play an active role in society. The emphasis was principally on participation, particularly in contexts of high levels of material deprivation and youth disaffection.
- SENSE.STEAM approach was applied as an opportunity to depart radically from conventional ideas of education, largely indoors, abstract, and static, and stereotyped impressions of STEM education as the domain of the powerful and the masculine.
- Creative methods for co-evaluation like mapping and portraits helpd to build participants' reflective consciousness of their role in their local environment, how to pay attention to things that are important for them, and towards which they could direct efforts for change.

- Issues of safety in the community (i.e. street lighting), availability of food and sense of well-being in schools, places to think with others and practice decision-making were important topics which were addressed directly by stakeholders attending the labs.
- While all partners managed to find spaces to undertake the activities, it was clear that the formal educational spaces in schools and Universities were largely at odds with their needs. Hence, both time and spaces for people to meet, feel comfortable and work freely were important considerations.
- An emerging finding was the recognition from stakeholders about the need to make such times and spaces for SENSE.STEAM initiatives a legitimate part of their education, for example through reforming schools schedule to free up students in the afternoon to engage with artistic and social activities or re-inventing the role of civic spaces such as libraries, to welcome the activities of the youth.

ACTION:

In some of the labs, the SENSE.STEAM approach was deployed to target key issues such as health, poverty, wellbeing; participants were engaged directly through both arts and sciences to impact public perception and redirect policy priorities for teacher preparation.
Experiences for partners in this group tended to be largely outdoors, either in public spaces or in formal and informal education contexts with the clear intention to connect the senses with the local reality;
Building on participants' reflective consciousness of their role in their local environment, the SENSE.STEAM approach was used to effect actual, physical changes in the outlook of their communities, for example through direct actions such as gardening, collection of data to present ot policymakers and symbolic enactments of problematic situations that were offered for discussion.
Key to all the activities was a long-standing effort to go beyond the privilege associated with formal institutions like the academy, and engage with local municipalities on the ground, build relationships of trust with participants, with teachers as well as children and their parents, and work closely with marginalized groups in society.
Many lessons learnt from partners engaged in ACTION included gaining access public spaces and make time for shared experiences and work towards addressing the shared needs of a community.

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7. Appendices

Appendix 1: SENSE. aligned co-evaluation activities

A SENSE. Evaluation Sequence

Materials Required

- 2 Pin Boards (cardboard can be used)
- Pins (at least 2 colors or different types)
- Printed out portrait silhouettes (see below)
- Printed out map of location
- Ideally A2 or A1, can be printed from www.openstreetmap.org
- Use zoom level 17 or 18 for neighborhood or very local area (you can see the zoom level as the first number in the url).
- Small dot stickers in three colors (or marker)

Before activity: Reflection Portraits
Estimated 5-10 minutes.
Every participant takes a portrait silhouette.
We are interested in gender as a variable, so participants attach a dot to the back of their portrait that they identify as woman, man, other.
Participants are then asked to reflect and draw on the portrait silhouette in one color.
The prompt for this is a general reflection on sensorial experiences at the moment.
Along the lines of (feel free to adapt):

- How do you expect to experience your senses during this time?
- When reflection and preparing for the experience now, how do you experience your senses?
- Draw in a way that represents these for you.
- Let people know that there was never any one response that is the or a correct response to questions or the sharing of experience. This is so essential, as an attitude of openness during this activity.

Pin the portraits in a place off to the side, so that they can be set aside for the activity and that people can find their portraits at the end.

After activity
Estimated 10 to 15 minutes

Re-reflection on portraits

With a new color, participants are asked to reflect again on their portraits, with similar questions after the activity.

- After the activity, where is your body sending you signals? Where in your body are you receiving the most signals, senses, and feelings?
- Where you do you feel tense and where do you feel relaxed
- Draw in a way that represents these for you.

Reflection on place
Looking at the map, facilitator leads a brief activity where participants mention to the classroom favorite places and least favorite places that are on the map. Pins or markers of different colors are used on the map to note these areas.

Participants then pin their portrait to the map in a place where they experience the senses that they have expressed in their portrait (can include a note suggesting participants choose outside of the activity room). The prompting question is along the lines of:

- *Place your portrait where you feel you experience the sense you have drawn just now.*

Don't worry about the portraits obscuring the map.
Do instruct that they indicate the place with the pin that they are using, not with the portrait as a whole.

Re-reflection on places with lens of inclusion and activity
Afterwards, if there is a time, it can be productive to invite a few words from participants as they observe the map and the placement of portraits. These can be noted down by the facilitator.

To be sent to us

- Take a high-resolution picture of the map with all of the portraits placed on them. Make sure this picture is clear and visually rich before proceeding to the next step. It may be best to do this in a room where you can control the light.
- Remove all of the portraits from the map and organize them by the gender chosen. Take clear high-resolution pictures of the portraits. (This can be done in groups, explore yourself the best way to do this for you in a way that makes clear pictures of each of the portraits, where details can be clearly seen).

A. Send us these two pictures.

Appendix 2. More SENSE. evaluation activities

Favourite places
Short Description

A detailed map of the area of the activity is placed on a table, and participants relate the SENSE. activity to their favourite and least favourite places, placing pins on these places on the map. Participants write about the places on sticky notes, including one word or phrase about how they feel about this place or why they chose it.

Alignment with Evaluation Goals
This activity explores how a SENSE. learning activity works with space, place and time through exploration of place-based connections and transformative potentials of activities, participants, communities, and local place.

This activity also aligns with:

- Sense! – using spatial proprioception and spatial thinking
- Imagine! – identifying strong positive and negative feelings relating to the activity and place, and thinking about how different spatial settings or approaches to place could make for different futures.
- Co-produce and Act! – Co-mapping leads to negotiations, conversations and engagement, while each participant is asked to participate.

For evaluation goal 2, this activity has a focus on the nature of transformation (positive and/or negative). The activity analysis could also include analysis of difference in submission.

Full description of activity (how to carry it out)

Facilitator will print out a map of the local area from OpenStreetmap (https://www.openstreetmap.org/) on paper (A4 size to A1 size, bigger is better), and place this map on cardboard on a table.

Participants will gather around the table and be instructed to take pins of different colours and reflect on the map in relation to the SENSE. learning activity. Participants will place pins of one colour on favourite places, and a different colour on least favourite places.

Participants will also write on sticky notes the name of a place and a word or phrase on a feeling or description of why a place was chose. Sticky notes are to be placed

on a wall and the group will discuss submissions, note important places for the group, or propose actions from the activity.

Materials based SENSE!

Short Description
In pairs, take a material that you have been working with in the activity today and apply it on to an A4 page in a way that you relate to the activity. Participants reflect on his activity on sticky notes and discuss as a group.

Alignment with Evaluation Goals
This activity closely aligns with Sense!, Create!, Co-Produce!. Imagine!

For evaluation goal 2, this activity has a focus on the materiality of transformation, and empowerment in making change and engaging and communicating in aesthetic and scientific ways with materials available.

Fully description of activity (how to carry it out)

Resources needed
A4 pages and leftover material from SENSE. activity.

Poetry, follow the rules!
Short Description
As a group, use different methods to come up with a long word or two words that relate to the learning activity. Participants will be given a short amount of time to write acrostic poems relating to their experience of the SENSE. learning activity.

Alignment with Evaluation Goals
This activity closely aligns with Sense!, Make! & Create!

For evaluation goal 2, this activity has a focus on the reflection on the 'if' and 'how' of transformation.

Fully description of activity (how to carry it out)
Acrostic poems are a type of poems where the first, last or other letters spell in a vertical line a particular word or phrase. For example:

Sense

Some storm is coming, and
Every moment I can feel it
Nose can smell it, ears can hear, even the toes can wiggle and feel
Soon there will be a change, I can sense it
Each rain droplet, announcing its nigh arrival

Resources needed
Pen and paper

Das arts concept reflection
Short Description
One participant is chosen as presenter at random. On small post-it papers, other participants write some concepts which for them relate to the presentation (one-word). The presenter hangs these on an A3 sheet of paper, closer by or further away from the word 'work', related to the Sense. activity. Hereby they demonstrate the hierarchy of importance: which concepts, according to their own view, relate to the activity, which don't?

The facilitator then picks out two concepts and asks the presenter why they are important or unimportant for the facilitator and group.

Alignment with Evaluation Goals

Fully description of activity (how to carry it out)

Resources needed

Blossom the tree!

Short Description

Participants are shown a half-blooming tree drawn on a flipchart paper and are asked to evaluate the activity by placing sticky notes on the flipchart with their comments about the content, logistics, and facilitator. On the blossomed side of the tree, participants can provide positive feedback, and on the non-blooming side, what needs improvement.

Alignment with Evaluation Goals

The evaluation method aims to assess the activities' methodology, content, and possible gaps that should be taken into account by the facilitator in the future. We can also use this method to understand what participants have learned by participating, and what they wish to learn in the future. This evaluation method should be completed right after the activity. The evaluation activity aligns with the following features of Manifesto: SENSE! Involve! Imagine! Make & Create!

Fully description of activity (how to carry it out)

On a flipchart sheet, the facilitator will draw a tree divided into two parts with a line, one side blooming and the other not. On the blooming side of the tree, participants will be asked to write about the activity, including how it helped them learn about STEAM education, what they discovered about sense, etc. , as well as what they

missed during the activity and what they learned, so the other side would flourish as well.

Note for a facilitator: Also, it might be interesting to remove the line and ask participants to arrange their notes accordingly.

Resources needed

A flipchart paper, sticky notes, pens and pencils.

Appendix 3. Post-activity survey instrument

5 point Likert scale

☐ 1 (Not at all) ☐ 2 ☐ 3 ☐ 4 ☐ 5 (Completely)

Subscale interest:
- I found that topic important.
- The information on that topic yields something to me.
- I want to learn more about that topic.
- The lesson of today was interesting for me.

Subscale well-being:
- I was satisfied with the lesson.
- I enjoyed the lesson.
- I was satisfied with the lesson.
- For me, it was a good lesson.

Subscale boredom:
- I felt bored.
- Today, I was sometimes absent with my thoughts.
- The lesson was to sleep in.
- The lesson took ages.

Demographic information
Gender: _____

Please indicate your age:
☐ 13-17 ☐ 19-25 ☐ 26-65 ☐ 65+

Formal education completed:

Primary school	☐ None	☐ Some	☐ Completed
Secondary school	☐ None	☐ Some	☐ Completed
Further Education	☐ None	☐ Some	☐ Completed

Your primary language(s) spoken: _____

Other languages spoken: _____

SGIC (Self-Generated Identification Codes) if needed
Adapt if necessary. We have feedback that in many places, for example, most people do not have middle names or just one middle name.

___ ___ ___ ___ ___

A B C D

A – The first letter of your mother's first name
B – Number of older siblings you have
C – Month in which you were born
D – First letter of your own middle name (blank if none)

Appendix 4. Reflective notes

Facilitators' reflections

- Describe if you have any updates to the activities planned and carried out
- *Was it a different group or activity? Have you changed how you would run the activity after reflection? How many times have you carried out this learning sequence since and/or plan to carry it out in the future?*

- Reflections on activity – *Tell the story of the activity. What happened first? Were there major variations on the plan? Give an expanded narrative.*

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*

What went well? What would you do differently? What was unexpected? What conclusions/ lessons/ comments for future STEAM Lab activities occur?

What were the planned links to:
- *Senses and sensory awareness*
- *Space and space-based awareness*
- *Social inclusion*

How have you reflected on these links in the learning sequences since the activity?

How have you reflected on how the activity integrates SENSE.STEAM educational key components? Note major and minor changes from the immediate post-reflection.

Participant reflections

For the SENSE. body portraits, the prompts would be as outlined in the original body portrait activity, with a modified beginning to reflect on the following.

"Think back to when we carried out the activity. In the time between participating in the activity and now, what senses have you associated with the activities we completed."

This alternative to the SENSE.-aligned evaluation uses the structure of the Das Theatre Feedback *Prompts:*

* AFFIRMATIVE FEEDBACK (+ NOT AFFIRMATIVE FEEDBACK): feedbackers give affirmative feedback by using one single sentence that is structured according to the following formula: "what worked for me was..." (10'). The facilitator writes essentials on A3 paper easel. In the second half, feedbackers are prompted to give feedback with “what didn’t work for me was...”.

* PERSPECTIVES: feedbackers use one single sentence that is structured according to the
following formula: "as a ... i need ..." (the perspectives you choose can be very diverse and even fictional: "as a woman/politician/dancer/programmer/visitor from mars/social activist/etcetera") (10')

* OPEN QUESTIONS: feedbackers pose questions which cannot be answered with a "yes" or a “no". the presenter doesn't answer these questions. (10')

* CONCEPT REFLECTION: on small post-it papers, feedbackers write some concepts which for them relate to the presentation. The presenter hangs these on an A3 sheet of paper. The moderator then picks out two concepts and asks the presenter why they are important or unimportant for him. (10')

Appendix 5. Code Book for the analysis of the sensory portraits

Theme	Code	Code Definition	Examples
Sense	Sense	This is an overarching thematic code on the theme of senses and sensing. Portrait drawing selections coded within this theme indicate an interpretation by coder that the participant reflecting and communicating their senses as they experience them. This interpretation is based upon the coder reviewing the prompt(s) given to participants, the description of the activity in the activity report, and interpretation of drawing sections as referring to physical senses (e.g. feeling and touch with hands and feet, sight, hearing, sensing feeling in body parts).	
Sense	Change in sense	Drawing selection indicates a change in sense in this part of the body or using this sense from pre-activity to post-activity. In this selection, coder interprets that the participant indicated sensing in this part of the body or using this sense in the pre-activity drawing, and then in the post-activity drawing will again indicate sensing in this part of the body or using this sense in a different way. This can be using a different drawing technique to communicate the type of sensing or sensorial experience, or expressions using symbols, words ore more.	Examples include using a different drawing technique to communicate the type of sensing or sensorial experience, or expressions using symbols, words ore more.
Sense	Expansion of sense	Post-activity drawing selection indicates sensing in a part of body or using a sense that was not indicated in the pre-activity drawing.	Examples include drawing to indicate feeling, sensing or attention in a hands, arms, legs, feet, and other

		In this selection, coder interprets that the participant indicated that they are aware of, focusing or communicating a sense or a sensory experience after the activity that they did not indicate in the pre-activity.	body parts or a communication of a sense like hearing or seeing in the post-activity drawing where not indicated in the pre-activity drawing.
Sense	Sense – no change	Drawing selection indicates no change in sense in this part of the body or using this sense from pre-activity to post-activity. In this selection, coder interprets that the participant indicated sensing in this part of the body or using this sense in the pre-activity drawing, and then in the post-activity drawing will again indicate sensing in this part of the body or using this sense in the same or similar way.	Examples include tracing over of previous drawings, repeated drawings, repeated or emphasized words or symbols.
Sense	Senses before	Pre-activity drawing selection indicates sensing in a part of body or using a sense that is not indicated in the post-activity drawing. In this selection, coder interprets that the participant indicated that they are aware of, focusing or communicating a sense or a sensory experience before the activity that they then did not indicate in the post-activity.	
Affective	Affective	This is an overarching thematic code on the themes of affect, feelings and emotions. Affect, feelings and emotion all generally refer to the sensations that are personal and reactions of self to the world (as set against sensing, which is more about the pre-reaction interpretation of the world's affect on our bodies). This theme can generally be understood as looking for emotions, i.e. an interpretation by the coder that the participant is reflecting on, processing and/or communicating emotions and pre-emotions.	
Affective	Affect – no change	Drawing selection indicates no change in affective indications in this part of the body or along this theme, and is indicated in both the pre-activity and post-activity drawings.	

		This selection can include indications along any of the four categories of affective indications – emotional symbols, implicit, intensity and/or words.	
Affective	Affect before	Pre-activity drawing selection affect or emotion in an aspect or part of the drawing not indicated in the post-activity drawing. This selection can include pre-activity indications along any of the four categories of affective indications – emotional symbols, implicit, intensity and/or words.	For example, the participant draws a heart in the heart-area of the portrait in the pre-activity but makes no affective indication in that area or on that theme (ex. Hearts in others areas of the drawing) in the post-activity drawing.
Affective	Emotional symbols	Post-activity drawing selection uses a symbol to indicate an emotion.	Examples include a smiley or frowny face, a heart, a question mark, a thought bubble.
Affective	Implicit	Coder interprets that the post-activity drawing selection communicates an emotional or affective process or attention, but it is not indicated using symbols, intensity or words. This category is where a coder clearly interprets the drawing selection as affective, but it does not fit into the other three categories.	Examples include attention in the drawing to the head and brain, the gut or heart. Or the drawing otherwise indicates less of a focus on sensing from the outside world and more of an internal reflection on feelings.
Affective	Intensity	Post-activity drawing indicates a strong affect or emotion through the intensity of the drawing. These selections indicate an affect, although interpretation of the type or meaning of this affect is more difficult to interpret.	Examples include blacking out the entire page, 'chaotic' drawings or drawings where clear force has been used in the drawing, including ripping the paper.
Affective	Words	Post-activity drawing indicates an affect or emotion using words.	Examples including writing 'Happy', 'Sad', 'Energy', 'Tired' on the portrait.
Context	Context	This is an overarching thematic code referring to themes of relating the portrait to outside the self. Selections on this theme are focused on participants 'drawing outside the lines', including making connections between conceptions of self to others, to the place of the activity and other places, and to	

		conceptions of self-identity in the context of others.	
Context	Context – others	Post-activity drawing includes other people or includes a reference to other people.	Examples include drawing other people and group activities.
Context	Context – place	Post-activity drawing includes other people or includes a reference to place, usually around the edges of the drawing. This code also indicates connections participants make to nature and other species, as well as to spaces where they participated in the activity or otherwise meaningful.	
Context	Context – self	Post-activity drawing includes drawings that indicate a conception of self connected to being perceived and relating to groups of other people. This mainly includes indications along lines of clothing, fashion, style, aesthetic shorthands.	
Context	Context – Self -> gender	This subcode is focused on drawings that indicate a conception of self that is symbolically or otherwise connected to conceptions of gender. The focus of this code is when drawings line up with common aesthetic shorthand of gender expression (long or short hair, dresses, makeup and jewelry). This is an expansive code – i.e. coders will include a selection when they are unsure if the selection is an expression of conceptions of gender. This allows for further analysis of all coded selections in more detail at a later stage.	
Context	Place – no change	Drawing selection indicates no change in indications of context and place, and is indicated in both the pre-activity and post-activity drawings.	
Check with facilitator	Check with facilitator	These selections are highlighted for checking in with the facilitator of the activity or Consortium partner for a range of reasons	

		One use of this code will be used if there has not been sufficient anonymization of portraits, in which case the coder will immediately contact the relevant Consortium partner contact for remedies	
Check with facilitator	Translating	These selections contain words in a language which the coder cannot easily understand or translate. The coder will contact the relevant Consortium partner if translation is feasible.	

Appendix 6. Code Book for the four EU priority areas

GREEN DEAL – educating towards a sustainable future

Definition: Visual representations that illustrate themes, concepts, or practices showing the promotion of knowledge, skills, attitudes, and values for sustainability and resource efficiency.
When to Use:

- When drawings depict scenes or activities related to environmental sustainability, such as classrooms, outdoor learning environments, or nature settings.
- When drawings highlight the objectives of the European Green Deal, such as reducing greenhouse gas emissions, decoupling economic growth from resource use, and inclusivity.
- When drawings show interactions between individuals (e.g., teachers and students) focused on nature, sustainability or engaging in sustainable practices.
- When drawings include elements showing appreciation and respect for nature, such as outdoor activities, planting or harvesting or scenes emphasizing the connection between humans and natural environments.

Examples:

1. Outdoor Learning Scenes:
    - Drawings of students and teachers engaged in activities in natural settings like woods, mountains, lakes, or the ocean.
    - Illustrations showing individuals appreciating nature and spending time outdoors as part of their learning experience.
2. Classroom Settings:
    - Images of spaces with reference to sustainability topics, such as climate change, biodiversity, and pollution.
    - Drawings of students engaging in STEAM activities.
3. Community and Collaborative Learning:
    - Visuals showing communities working together to embed sustainability within the education system.
    - Illustrations demonstrating cooperative efforts to promote inclusivity and ensure no person or place is left behind.
4. Action Competence and Skills Development:
    - Drawings that highlight students developing key competences like sustainable acting, system thinking, critical thinking, creativity, and innovation skills in a sustainability context.
    - Visuals of individuals or groups participating in problem-solving activities related to sustainability issues.
5. Personal and Moral Connection to Nature:

- Illustrations showing individuals feeling spiritually or emotionally replenished by their experiences in nature, emphasizing the intrinsic value of the natural world.
- Drawings depicting a lifestyle that reflects respect for and commitment to sustainable living, as seen through individual actions and moral codes aligned with environmental education.

Health

Definition: Visual representations that illustrate themes, concepts, or practices promoting a holistic understanding of health, encompassing physical, mental, and social well-being, in both individual and community contexts.
When to Use:

- When drawings depict educational scenes or activities promoting a comprehensive view of health, including physical, mental, and social aspects.
- When drawings highlight communal or collective health promotion efforts, emphasizing the importance of shared experiences and active listening.
- When drawings show individuals or groups engaging in health-related educational activities that integrate self-reflection, prevention, and care provision.
- When drawings feature elements related to understanding health diversity, identity, and the necessity for inclusive health practices and discussions.

Examples:

1. Holistic Health Promotion:
    - Drawings of individuals participating in activities that promote physical, mental, and social well-being, such as group exercises, mindfulness sessions, and community gatherings.
    - Illustrations showing educational materials or settings that emphasize the holistic nature of health and well-being.
2. Community Health Initiatives:
    - Visuals depicting community discussions or group sessions where individuals share experiences and engage in active listening about health-related topics.
    - Drawings showing community health programs that involve a diverse group of participants, highlighting inclusive health practices.
3. Self-Reflection and Preventive Health Education:
    - Illustrations of individuals or groups engaged in self-reflective practices such as journaling, meditation, or preventive health measures.
    - Drawings depicting educational activities that teach skills and competencies for proactive health management and care provision.
4. Mental Health and Social Context:
    - Visuals that incorporate mental health as an integral part of overall health, such as support groups, therapy sessions, or mental health workshops.
    - Drawings showing family members or caregivers involved in mental health education, supporting individuals with mental health issues.

5. Diversity and Identity in Health:
    - Illustrations that reflect the diverse understanding of well-being among different individuals and communities, emphasizing the need for personalized health approaches.
    - Visuals depicting discussions or activities that address identity and identification in the context of health, promoting an inclusive dialogue about well-being.

Work-readiness

Definition: Visual representations that illustrate themes, concepts, or practices promoting skills, aptitudes, and attitudes necessary for integration and success in the workplace or relating work with societal or industry needs, focusing on transferable, practical and soft skills.

When to Use:

- When drawings depict educational scenes or activities aimed at developing work readiness skills such as problem-solving, teamwork, communication, adaptability, and other soft skills.
- When drawings highlight vocational training programs, employer-sponsored events, or work-based learning that contribute to work readiness.
- When drawings show individuals or groups engaging in activities that build general workplace attributes, such as punctuality, strong work ethic, and positive attitudes.
- When drawings feature elements illustrating the integration of skills necessary for both simple and complex job positions.

Examples:

1. Soft Skills Development:
    - Drawings of individuals participating in workshops or training sessions focused on improving communication, teamwork, problem-solving, and adaptability.
    - Illustrations showing activities promoting punctuality, motivation, strong work ethic, and positive attitude in a workplace setting.
2. Work-Based Learning and Vocational Training:
    - Visuals depicting students or trainees involved in internships, or on-the-job training initiatives.
    - Drawings showing events or scenarios where individuals are gaining skills and knowledge relevant to workplace culture and demands.
3. Teamwork and Collaboration:
    - Illustrations of group projects or collaborative tasks that require individuals to work together.
    - Drawings showing interactive learning environments where participants engage in activities that build teamwork and cooperative skills.
4. Adaptability and Critical Thinking:
    - Visuals showing individuals dealing with changing environments or unexpected challenges, emphasizing adaptability and quick thinking.

- Drawings of scenarios where participants engage in exercises or simulations that foster critical thinking and decision-making skills.

5. Planning, Organizing, and Controlling:
   - Illustrations highlighting individuals or groups involved in planning, organizing, and executing tasks or projects.
   - Visuals of educational settings that emphasize the development of executive and cognitive functions crucial for professional environments, such as STEAM-related activities.
6. Positive Attitudes and Motivation:
   - Drawings showing motivational aspects of education related to work readiness, such as goal-setting exercises, motivational speeches, or role-model interactions.
   - Visuals illustrating positive reinforcement and encouragement in developing a strong work ethic and committed attitude towards work duties.

Digitisation

Definition: Numerical data, Visual representations or other formats of digitsed content that addresses themes, concepts, or practices related to the process of transforming analogue outcomes into digital formats or vice versa and the integration of digital technologies into various areas of life, especially focusing on accessibility, communication, collaboration, and innovation..

When to Use:

- When drawings depict educational or social scenes that involve the use of digital technologies and tools.
- When drawings highlight the opportunities and challenges of digitization for young people, such as digital literacy, privacy, and cybersecurity.
- When drawings show individuals or groups engaging in activities that promote digital accessibility, communication, collaboration, and creativity.
- When drawings feature elements that demonstrate the integration of digital technologies into learning, work, or social environments, especially in the context of the SENSE project.

Examples:

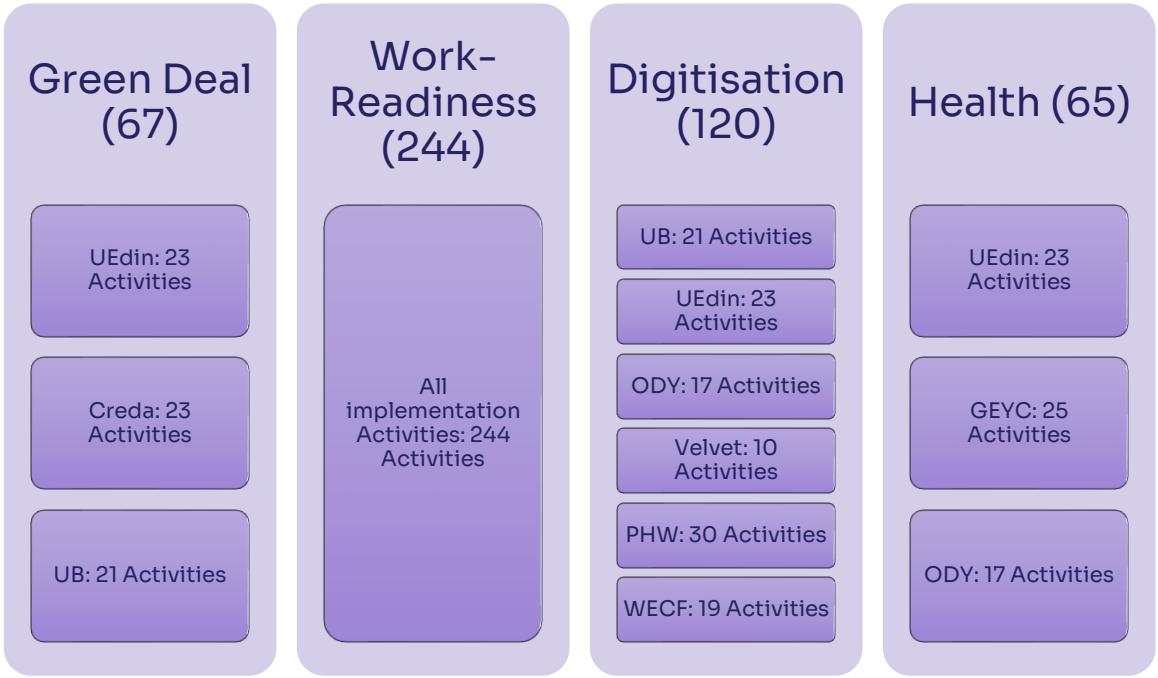
1. Accessibility:
   - Drawings showing young people accessing digital resources on various platforms and devices, illustrating inclusiveness regardless of technological availability.
   - Visuals depicting adaptations for young people with a variety of abilities and disabilities, such as sharing content in different formats.
2. Communication:
   - Illustrations of youth engaging with digital devices that make content more interactive and engaging, such as social media, online forums, and virtual meetings.
   - Drawings showing the use of youth-friendly communication channels to share outcomes, promote projects, and facilitate dialogues.

3. Collaboration and Participation:
    - Visuals depicting youth involvement in digital projects, online discussions, or collaborative digital platforms that enhance their participation.
    - Drawings of young people actively contributing to shaping project activities and outcomes through digital means.
4. Creativity and Innovation:
    - Illustrations showing young people using digital tools to experiment, innovate, and test new ideas, particularly in STEAM (Science, Technology, Engineering, Arts, and Mathematics) labs.
    - Drawings depicting scenarios where digital technologies enable creative expression and problem-solving.
5. Digital Literacy and Cybersecurity:
    - Visuals that highlight the importance of digital literacy skills among youth, such as understanding how to use digital tools effectively and safely.
    - Illustrations showing educational activities or discussions related to privacy and cybersecurity in the digital age.
6. Engagement through Digital Technologies:
    - Drawings showing how digitization enhances learning experiences, such as virtual classrooms, online workshops, or digital simulations.
    - Visuals depicting the immersion of young people in digital environments that promote active engagement and participation.

Appendix 7. Mapping Process on EU policy areas – work

- Activities per Lab
- Stakeholders Overall (= participants overall)
- Percentage: the clusters labs' activities of overall activities
- Percentage: the clusters participants of overall participants

How Many?



Implementation Activities per Cluster Topic:

Cluster	Implementation Activities & Percentage of overall activities	Labs
Green Deal	67 (27,46%)	Creda: 23; UEdin: 23; UB: 21
Work Readiness	244 (100%)	Creda: 23; GEYC: 25; HB: 16; HVL: 33; Louvre: 11; ODY: 17; PHW: 30; UB: 21; UEdin: 23; Velvet: 10; VilVite: 15; WECF: 19; Sibylle: 1
Digitization	120 (49,18%)	ODY: 17; PHW: 30; UB: 21; UEdin: 23; Velvet: 10; WECF: 19

Health	65 (26,64%)	GEYC: 25; ODY: 17; UEdin: 23

How many stakeholders are involved?

Stakeholders (Participants) overall (from those 188 implementation activities we have participant data on)

- Creda: 467
- GEYC: 245
- HB: 118
- HVL: 829
- Louvre: 181
- ODY: 189
- PHW: 237
- Theatre of Research: 13
- UB: 866
- UEdin: 334
- Velvet: 167
- VilVite: 467
- WECF: 189

Participants (involved stakeholders) per Cluster Topic

Cluster	Stakeholders and percentage of overall stakeholders	Labs
Green Deal	1667 (of 4302) = 38,75%	Creda: 467; UEdin: 334; UB: 866
Work Readiness	4302 (of 4302) = 100%	Creda: 467; GEYC: 245; HB: 118; HVL: 829; Louvre: 181; ODY: 189; PHW: 237; UB: 866; UEdin: 334; Velvet: 167; VilVite: 467; WECF: 189; Sibylle: 13
Digitization	1982 (of 4302) = 46,07%	ODY: 189; PHW: 237; UB: 866; UEdin: 334; Velvet: 167; WECF: 189
Health	768 (of 4302) = 17,85%	GEYC: 245; ODY: 189; UEdin: 334