SENSE.

SENSE. The New European Roadmap to STEAM Education

D3.3 – Report on Stakeholder Challenges and Needs for future-making STEAM Education in Europe

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Abbreviations and acronyms

Abbreviation or acronym used in this document	Explanation
STEAM	Science, Technology, Engineering, Arts and Mathematics
STEM	Science, Technology, Engineering and Mathematics

Glossary

Term	Definition used or meaning in the SENSE. project	Reference or source for the definition if applicable
SENSE. stakeholder	A stakeholder in the project SENSE. is any person, organisation or group that is affected by or who can affect the outcomes of this project	SENSE. Description of Action
SENSE.STEAM	The SENSE.STEAM methodology, comprising a dedicated educational model and its pedagogy, with i) STEAM inquiry, ii) citizen science and art practices, iii) learner centredness and iv) reflective feedback as its building blocks.	SENSE. Description of Action

STEAM labs	The project's implementation activities will take place as part of a set of STEAM Labs, set out to reach potential change agents and enable them to become advocates for STEAM.	SENSE. Description of Action
STEAM beneficiaries	Stakeholders that should benefit from the new approach to STEAM education and the SENSE. Roadmap.	SENSE. Description of Action
Gender equality	The understanding that women and men have equal conditions for realizing their full human rights and for contributing to, and benefiting from, economic, social, cultural and political development.	A guide for ensuring inclusion and equity in education', UNESCO 2017
Inclusion	A process that helps to overcome barriers limiting the presence, participation and achievement of learners.	A guide for ensuring inclusion and equity in education', UNESCO 2017
Inclusive education	Process of strengthening the capacity of the education system to reach out to all learners.	A guide for ensuring inclusion and equity in education', UNESCO 2017
Diversity	People's differences which may relate to their ethnicity, gender, sexual orientation, language, culture, religion, mental and physical ability, class, and immigration status.	A guide for ensuring inclusion and equity in education', UNESCO 2017

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

The Stakeholder Challenges and Needs Report for a New European Roadmap to STEAM Education aims to provide an overview of the stakeholders of the SENSE. project and to give an overall picture of their needs and challenges in the context of future-making STEAM education. The document first describes the target groups that will benefit from new approaches and tools for STEAM education and from the results of the New European Roadmap for STEAM Education that will arise from the SENSE. Project.

It also reflects the activities carried out in Work Package 3, which included a phase of listening to the needs and gathering the insights and ideas of SENSE. beneficiaries through interviews conducted by the partners with their stakeholders.

These results will provide guidance for the next phases of the project in terms of the relationship between stakeholder engagement and the definition process of the SENSE. methodology, the participation of beneficiaries in the STEAM labs and the definition of the New European Roadmap for STEAM Education.

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1. Introduction

1.1. Purpose of the document

Stakeholders are basically any group or individual who has a 'stake' in a process because they have an interest in or are affected by an activity in some way. Key categories of stakeholders include those who have an influence on the activity (e.g. teachers, parents), those who have (or are perceived to have) an impact on the resource (e.g. communities adjacent to resources, decision makers), those who have a shared interest in the activity (e.g. other indirect beneficiaries, such as policy makers or consumers), and lastly the wider public.

The purpose of this document is to provide an overview of the stakeholders and target groups that the SENSE. project aims to engage and involve. It discusses the rationale for including more substantive provisions for stakeholder engagement in general and for the SENSE. Stakeholders in particular (see section 2) by analysing their needs and challenges in relation to STEM and STEAM education.

In addition, this report provides a snapshot of the project's needs and challenges by directly incorporating the insights and ideas of stakeholders from partner organisations as well as future participants in the project's implementation, the STEAM labs. Specifically, it presents and analyses a collection of feedback on how SENSE. stakeholders perceive the current state of STEM and STEAM education, and how they envision the potential outcomes that the SENSE. project can achieve.

Therefore, this report will provide some practical guidance on how to identify and understand the different intensities, specific needs and differences that exist between the different groups that the project is targeting. This will enable the qualification of interventions and activities to be consistently aligned with the needs and challenges highlighted by stakeholders, ultimately leading to the development of an effective and responsive roadmap for STEAM education.

1.2. Structure of the document

The document collects and presents the outcomes of the work carried out for the analysis and involvement of the SENSE. project beneficiaries.

The first chapter introduces the purpose of this report and shows its implications and interrelationships with the other actions envisaged in SENSE.

The second chapter frames the topic of SENSE. beneficiaries and their engagement by analysing the context of the project and identifying the added values that make it important to address stakeholder participation to effectively co-create a roadmap for STEAM education.

The third chapter presents the listening phase carried out by the consortium partners and analyses the collected inputs and insights.

The fourth chapter presents the conclusions in the light of the next actions to be implemented within the project.

1.3. Relationship with other deliverables

Together with the other deliverables foreseen in Working Package 3 (D3.1 Report on the STEAM DNA Workshop, D3.2 Report on the Citizen Science and Art-Practices Workshop and D3.4 Report on knowledge and practices for a New European STEAM education), this report contributes to establish the SENSE.STEAM methodology (D3.5 The SENSE.STEAM methodology) that will then feed the work of WP4 (Steam Labs), WP5 (Cross-cutting issue: space), WP6 (Cross-cutting issue: social inclusion) and will be incorporated into the Roadmap in WP7 (Consolidation of the STEAM Roadmap and its supporting tools).

1.4. Acknowledgements

This report is the result of collaboration among multiple authors. Specifically, Anna Samwel from WECF and Theodoris Kostoulas from Odyssea were responsible for writing Section 2.1, drawing upon their experiences and expertise in addressing gender equality and the needs of youth and vulnerable communities. Adelina Dragomir and Diana Adela Ioniță from GEYC took charge of Section 2.3, which they developed based on the guidelines outlined in Deliverable D2.2, while Anne Krebs and Anna Samwel drew the conclusions. The writing of the remaining sections and data analysis were carried out by Carolina Bianchi and Daniela Conti from CREDA onlus.

This document benefits from the accurate work of the Consortium partners who operated in their respective contexts and territories, collaborating with their beneficiaries to gather the data used to formulate the indication and key insights here presented to effectively and constructively engage stakeholders in the co-creation process of the project.

A special acknowledgement goes to Manuela Re of Trelleborg for her text review.

2. SENSE. stakeholders

Strengthening SENSE.'s stakeholder engagement provisions will improve the effectiveness of implementation, the perceived relevance of the SENSE. Roadmap and therefore the impact of the project. Stakeholder engagement is also essential to enhance the long-term sustainability of the project's ambitions. In addition, stakeholder engagement can be implemented efficiently, based on established good practices, without overburdening stakeholders.

The following is a list of the beneficiaries targeted by the SENSE. project and who are expected to benefit from a new approach to STEAM education:

- **Students aged from 13 to 18 years old**, who need to make decisions on their future studies.
- **Students 19-25**, who need to decide about further study and/or choose a professional career.
- **Girls who are afflicted by gender stereotypes** limiting their access to science-related studies and professions.
- **Parents, who are involved in supporting the education and decision-making processes of their children** at various stages of the educational life-course.
- **Private and public sector employers and businesses**: who need to have work ready and creative students matching new job profiles related to digital and green transitions.
- **Schools, teachers, educators**, in formal and informal settings as well as science museums who need to be equipped with hands-on pedagogical tools to implement STEAM in curricula.
- **Cultural and artistic institutions** as spaces for the learning of science in relation to society. We want to bring to the fore and make explicit their role as legitimate and powerful informal learning spaces where science and the arts can productively meet.
- **Academic staff in higher education and research**, to promote and integrate STEAM inquiry and research methodologies in PhD programmes and research projects including Horizon Europe.
- **Policy makers and decision makers** who derive education policies and curricula embedding STEAM throughout the learning continuum.
- **The general public**: the development of a scientific literate citizenry is a fundamental goal of SENSE. that believes that social challenges are best dealt with by informed and scientifically literate citizens who have made lifelong learning their way of life.

The involvement of beneficiaries in SENSE. should not be perceived merely as a passive role as recipients of activities and measures. Instead, they are individuals, institutions, and organizations that, together with partners in each local context, are active in co-creating and shaping the methodology and tools for transforming the way STE(A)M is currently taught in formal and informal settings. The aim is to empower

all citizens, regardless of their gender and their social and economic backgrounds, to become active learners and to actively live out the social challenges we face.

2.1. The value of stakeholders' participation in SENSE.

Stakeholders' participation in the implementation of the SENSE. project is essential in several ways. The SENSE. project aims to create and deliver a New European Roadmap to STEAM education. The roadmap will affect a wide range of stakeholders coming from several target groups including young people, parents, educators, businesses, and policymakers. By involving them in the development process, the project team will gain valuable insights concerning their needs and ensure that their expectations are considered and increase the relevance and effectiveness of the roadmap.

Taking into account the stakeholders' needs and expectations will better align the project's goals and objectives, leading to improved project outcomes and increased stakeholder satisfaction. Stakeholders bring various perspectives and expertise to the table, which can help identify potential risks and opportunities that may have been overlooked, leading to more effective project planning. It is crucial for the project that the stakeholders will be involved in a co-creation procedure, under optimal conditions for them to share their experience to build an overview of needs on a larger European scale.

When stakeholders are involved in the project's development and implementation, they are more likely to feel a sense of ownership and investment in the project's success, thus increasing the support and commitment to the project's goals and objectives. By being actively involved, the stakeholders are more likely to develop a strong intention to support the roadmap's smooth implementation in the long run, especially since there are strong preconceptions and expectations across Europe as to what STEM and STEAM are. Their involvement can help identify and overcome potential barriers, initially by giving them the tools to identify the current limitations and then by giving them a role in developing activities that can challenge the existing beliefs.

Another important point regarding the involvement of the stakeholders is the dissemination of the roadmap. At that stage, they become the advocates for the roadmap and are more likely to share it with their networks, thus increasing the reach of the beneficiaries, and the awareness and adoption of the roadmap, which is critical for achieving the project's goals of promoting STEAM education and reducing gender stereotypes.

Finally, stakeholders' participation can contribute to the inclusiveness and equitability of the SENSE. project. By involving a diverse range of stakeholders,

including those from underrepresented groups, the project team can control whether the roadmap is accessible and relevant to all learners. This is particularly important for reducing gender stereotypes and promoting inclusion, which are key cross-cutting themes in the project. When stakeholders are actively involved in the project, they are more likely to have a clear understanding of the project's objectives, timelines, and potential impacts. This can lead to improved communication and collaboration between all parties involved, as well as increased trust and transparency in the project's implementation.

In conclusion, involving stakeholders in the development of the Roadmap to STEAM education is a key factor since their participation can help the project team by achieving:

- Improved decision-making
- Higher level of engagement
- Higher impact, more relevant project outcomes
- Smooth implementation process
- Transparency and inclusion

2.2. First mapping of stakeholders' needs

The partners, each representing a stakeholder in the roadmap, discussed their own needs and challenges related to STEAM education during the first workshop of the project, the STEAM DNA Workshop, held at the Norwegian University of Applied Sciences (HVL) in Bergen on 15-17 November.

In addition to the stakeholders already identified for the project, at this workshop participants began to map the STEAM stakeholder landscape in more detail. It became clear that their key characteristics needed to be analysed and qualified systematically and with greater detail, based on the knowledge and specific access to audiences that each consortium member could bring from their particular context.

Specifically, the following target groups were identified as critical for the project:

- *Youth*, including sub-groups such as minorities/migrants, girls and other vulnerable groups. Within these, there is a need to diversify interventions, taking into account the following age groups
  - Young adults from 19 – 25 years old.
  - Teenagers from 13 – 18 years old.
  - Young people under the age of 12. Although not initially considered as beneficiaries in the original proposal, it was recommended to pay special attention to this age group. In many European countries represented in the consortium of partners, young children already have to make choices about their further school career, which can have a significant impact on their chances of pursuing a STEM/STEAM career later in life.

- *Young women and girls* as a defined group because they are currently disadvantaged. The partners agreed to pay special attention to this objective throughout the project.
- *Teachers*. Their participation is seen as fundamental, as they can directly benefit from the results of SENSE, and at the same time their input is needed throughout the project to ground the roadmap in the context of formal and informal education.
- *General public*. SENSE. will benefit from the involvement of any citizen (employers, employees, unemployed, parent, family, elder) and it might have a great impact also for them as lifelong learners.
- *Among policy makers*, special attention should be given to Ministries of Education and Culture, Local Authorities, the European Commission, other legal or political bodies that could benefit from or adopt the New European Roadmap for STEAM Education and/or change curricula and support the project.
- *Journalists and content creators*. Although not listed, their collaboration could be helpful in communicating the value of STEAM education to the general public.
- *Educational institutions* who decide to do/propose SENSE.STEAM practices and labs together. Within this group, it is also necessary to consider scientific and artistic communities to meet their content and place-based knowledge.

Another aspect that was considered essential to develop in the process of defining the project methodology was the characterisation of the project beneficiaries. During the workshop, the partners initiated the mapping of essential characteristics for young people, teachers, and policy makers, based on their own experiences as well as on the needs and feedbacks observed in other educational projects and contexts, such as those related to the SENSE project.

What emerged is briefly reported later in this report and can also be analysed further in deliverable D3.1.

All beneficiaries, particularly young people, girls and vulnerable groups need to develop *critical skills* such as critical communication, critical thinking, and relevant skills to navigate society and make informed career choices. They also require *personal development* to foster self-awareness, character development, self-determination, self-directed learning, the abilities to learn how to learn and to function independently. Besides, the consortium pointed out the importance of fostering *intrinsic values* – among them climate, environmental and social justice, care for others, equality, creativity, sense of belonging and sense of responsibility. These values are crucial for individuals to become agents of change, act upon communities' needs and issues, and connect with the natural world.

When considering the specific learning environments of young people, it is important to recognise a number of constraints. Educational institutions may find it difficult to implement changes in their teaching methods. In addition, school curricula tend to

be rather rigid and often lack interdisciplinary approaches. Furthermore, persistent stereotypes, such as the belief that young people should only listen and not express their opinions and ideas, or that science is complex and only suitable for high-achieving students, can hinder the effective implementation of STEAM education.

Regarding teachers, there is a need for ***better training in teaching methods and addressing 21st century issues*** such as sustainability, digitization, critical thinking. Availability of quality ***STEAM curriculum materials and tools***, as well as the implementation of ***open school systems*** that allow sharing and collaboration within the educating community are identified as key priorities for the SENSE. project.

During the final discussion, the consortium agreed that this initial mapping should be followed by an in-depth study, actively involving and engaging the SENSE. project stakeholders to further explore and address their needs and perspectives.

2.3. Stakeholders' engagement in SENSE.

SENSE. is grounded in the consolidated methodology for stakeholders' engagement, described by Annika Jaanso within the project Inter Ventures on behalf of AEBR (Jaanso, A. 2019). SENSE. stakeholders' engagement strategy considers a spectrum of actions from mapping needs to co-creation which foresees the following steps:

1) Understand and identify who should benefit from the new approach for STEAM education.
2) Identify existing and ongoing STEAM initiatives to identify synergistic opportunities.
3) Engage beneficiaries for their effective and meaningful participation in SENSE.
4) Co-define a first vision of the roadmap.
5) Ensure that SENSE. outputs and results add value to STEAM beneficiaries.

At the time of the publication of this report, that is the 10th month of the SENSE. project, in the context of Work Package 2 - (Uptake and Sustainability), the dissemination, exploitation and communication plan of SENSE. was developed. It is a guide for the design and implementation of the strategies and activities of communication, involvement, dissemination, and sustainability of SENSE. It provides guidance to reach the heterogeneity of SENSE. stakeholders and to ensure that results will be widely adopted and used by them.

This plan unfolds starting with raising awareness among the audiences on the key concepts with which partners will operate envisioning the concrete action to work with participants. It also plans the communication of project results with the aim of encouraging their use in various contexts. Based on what each of the partners shared in the preparation phase of this plan, key messages were suggested for each specific

target audiences which the consortium can reach as presented extensively in D2.2 and here summarised in the table 1.

Table 1: Challenges and key messages for stakeholders' engagement.

SENSE. target groups	Challenge	Key messages
Students • 13-18 years • 19-25 years	Who need to make decisions on their future studies and about further studies and choose a professional career	• As a learner, you are actively creating your own knowledge. • The learning process is (should be) a multisensory exploration. • You can experience in practice the importance of Green Deal and Digitisation. • STEAM education prepares you to become active citizens and ready for the world of work.
Girls and women	Who are afflicted by gender stereotypes limiting their access to science-related studies and professions.	• Scientific learning is (should be) for all. • Community-based STEAM activities are (should be) meaningful and accessible to all.
Policy makers	Who derive education policies and curricula embedding STEAM throughout the learning continuum	• Science-literate society is critical for the future of a prosperous and sustainable planet. • Europe needs more scientists. • Social inclusion and STEAM education interact and influence each other. • The integration of the Arts and spatial literacy will develop new professional figures at the interface between scientific research to science communication and public engagement. • The support of school communities – encouraging in school stakeholders/actors to take leadership in STEAM Education • Trainings for teachers on STEAM – mandatory for teachers in schools • Integrating STEAM in the educational curriculum
Businesses (private and public sectors, SMEs, and large companies)	Who need work ready and creative students matching new job profiles related to digital and green transitions	•The integrated inquiry provides a methodological background for a learning continuum and is responsive to societal and business needs. •Mapping the current business needs and linking them to education supports the development of work-ready students and graduates. •The integration of the Arts and spatial literacy will develop new professional figures at the interface between scientific research to science communication and public engagement.
Museums and science centers	Spaces where learning of science in relation to society needs to happen and science and the arts can productively meet.	• An Art-based Citizen science approach facilitates engagement of citizens with both, scientists and artists, science labs and art places to explore. • Community-based STEAM activities are (should be) meaningful and accessible to all.

Teachers and educators	Who need to be equipped with hands-on pedagogical tools to implement STEAM in curricula	• The renewal of science teaching can be achieved by integrating the Arts into STEM. • STEAM education is (should be) a learning continuum. • The new SENSE.STEAM educational model and pedagogy adheres to a learner centered approach. • The learning process is (should be) a multisensory exploration and it is necessary to challenge conventional ideas of educational space towards a model that supports sensory diversity. • What students are taught in science class should be put in relation to their personal lives. • Science teaching should value students' sensory experiences, creativity, emotions, values, and attitudes towards STEM. • It is important to consider the needs of industry in education and to develop work-ready students and graduates.
Researchers and higher education sector	Who need to integrate STEAM inquiry and research methodologies in PhD programs and in research projects including Horizon Europe	• The renewal of science teaching can be achieved by integrating the Arts into STEM. • The integrated inquiry approach incorporates methods from Science, Technology, Engineering, the Arts, Artistic research, and Aesthetic education, as well as Mathematics, creating a truly transdisciplinary starting point for a highly adaptive pedagogy. • The new SENSE.STEAM educational model and pedagogy makes a radical shift from viewing learners as knowledge receivers to active creators of their own knowledge, promoting self-directed learning and empathy with others. • Social inclusion and STEAM education interact and influence each other. • It is important to consider the needs of industry in education and to develop work ready students and graduates. • The integration of the Arts and spatial literacy will develop new professional figures at the interface between scientific research to science communication and public engagement.
Families and communities	Who need to support the education and decision-making processes of their children at various stages of the educational life-course	• Social inclusion and STEAM education interact and influence each other. • STEAM education prepares students to become active citizens and ready for the world of work.
General public	Who need to develop a scientific literate citizenry in a lifelong learning context	• Scientific learning is (should be) for all. • Science-literate society is critical for the future of a prosperous and sustainable planet. • The learning process is a whole process.

3. Stakeholders' needs and perspectives assessment.

With the above in mind, and more specifically with the general aim of initiating engagement and participation of SENSE. beneficiaries, in-depth work through local interviews was established as part of the activities carried out in WP3. A protocol for assessing stakeholders' needs and collecting their feedback was established and shared with partners. Each partner then contacted their local stakeholders, conducted interviews and shared the results. The analysis of the responses and key findings from this work are described below.

3.1. Objectives

The objectives of the assessment of stakeholders' need were the following:

- Improve the quality of the activities foreseen in SENSE., bringing them closer to the real needs of citizens, students, girls, disadvantaged youth, teachers, employers, policy makers thanks to their ideas and suggestions, through which a more complete knowledge of needs can be achieved.
- Promote processes of innovation.
- Mobilise resources, activate active networks between partners and stakeholders, empower and motivate participants and stakeholders to strengthen partnerships for better science education..
- Improving transparency and outreach potential of the SENSE. project.

3.2. Approach to engagement

Stakeholders are invited to be part of the process to address their needs and ensure that the project outcomes are grounded in the real context of the formal and informal STEAM education landscape. In this first phase, which focused on defining the methodology, engagement began with each partner identifying their local beneficiaries. In the second phase, they were invited to participate in the project and to be interviewed in order to gather their insights for further refining the methodology and consequently the project actions, such as the local STEAM labs and their requirements and outcomes.

It should be noted that these initial phases of involvement, as described here, will need to be followed by later phases during the implementation of the STEAM Lab and the development of the STEAM Education Roadmap. These later phases will also need to include moments to verify the alignment between what has been achieved and the previously defined expectations and specifications.

3.3. Interviews

To consolidate and enrich the results of the initial stakeholders mapping conducted during the STEAM DNA Workshop, direct involvement of the target groups was sought. Through interviews, a collection of ideas, insights, and feedback was gathered, with the aim of gaining a deeper understanding of the needs and constraints faced by participants in the SENSE. project.

In order to conduct the local interviews and to subsequently analyse the responses comprehensively, the following protocol was established.
Firstly, based on the landscape of STEAM beneficiaries identified during the STEAM DNA Workshop, specific target groups were defined:

- Young people (aged 19-25)
- Parents and/or educators of young people aged 13-18
- Educational institutions (such as school headmasters, teachers from secondary education, educators, explainers, educational programs developers, science communicators)
- Business (Companies/ Industries/ social enterprises interested in a skilled and creative workforce)
- Policy makers (such as municipalities, local administrators, local, regional, and national officers of the ministries of education)

Secondly, in order to ensure a broad representation of all target groups, each partner was asked to identify at least two or more representatives of their beneficiaries, taking into account the categories mentioned above. Given the heterogeneity of the Consortium partners and their varying degrees of involvement with different target groups in their daily work, the involvement of all partners as a whole Consortium in this assessment activity allowed the full spectrum of participants to be concretely involved. This approach also lays the foundation for the participation and organisation of the upcoming local STEAM workshops of WP4.

Each partner contributed to the survey. Oral interviews were preferred and could be conducted in person, by telephone or by online teleconference. If necessary, partners had the flexibility to use other types of data collection.

The proposed questions were the following:

1. What are the constraints of current science education in your context and from your point of view?
2. What do you see as the main barriers to participation, especially for girls?
3. What strategies and approaches have you found useful to promote inclusion and participation in science education?

4. In what way do you think the integration of science and arts can improve STEM education of pupils from different backgrounds and contexts?
5. What benefits do you foresee for you or your organization from the completion of the SENSE. project?
6. Do you have any suggestions for us?

The interviews began with a brief overview of the SENSE. project, its objectives and how the opinions and information gathered would be used. A sample letter of introduction was shared with the partners, which could be adapted to suit individual local contexts and circumstances. The letter is included in Annex 1.

Following the interviews, each partner completed an electronic questionnaire (Google Form) for each interview, documenting the responses collected (see Google Form in Appendix 2). If an answer was too long, the interviewer and the interviewee agreed on a summarising sentence to be included in the form without any changes.
With regard to data management and protection, the information was collected in accordance with the respective national regulations.

The data was reported anonymously in the Google form and then analysed in a collective combined manner.

The interviewed participants' data are and will remain confidential and anonymous.

3.4. Results: beneficiaries' points of view on SENSE.

In total, 47 interviews have been completed. The distribution of the target groups and countries is presented in figure 1 and figure 2, respectively.
Moreover, the obtained distribution may also reflect the current types of beneficiaries that the partners already engage with. This distribution can provide valuable insights for identifying target groups and planning future engagement activities, aiding in communication and improvement efforts.

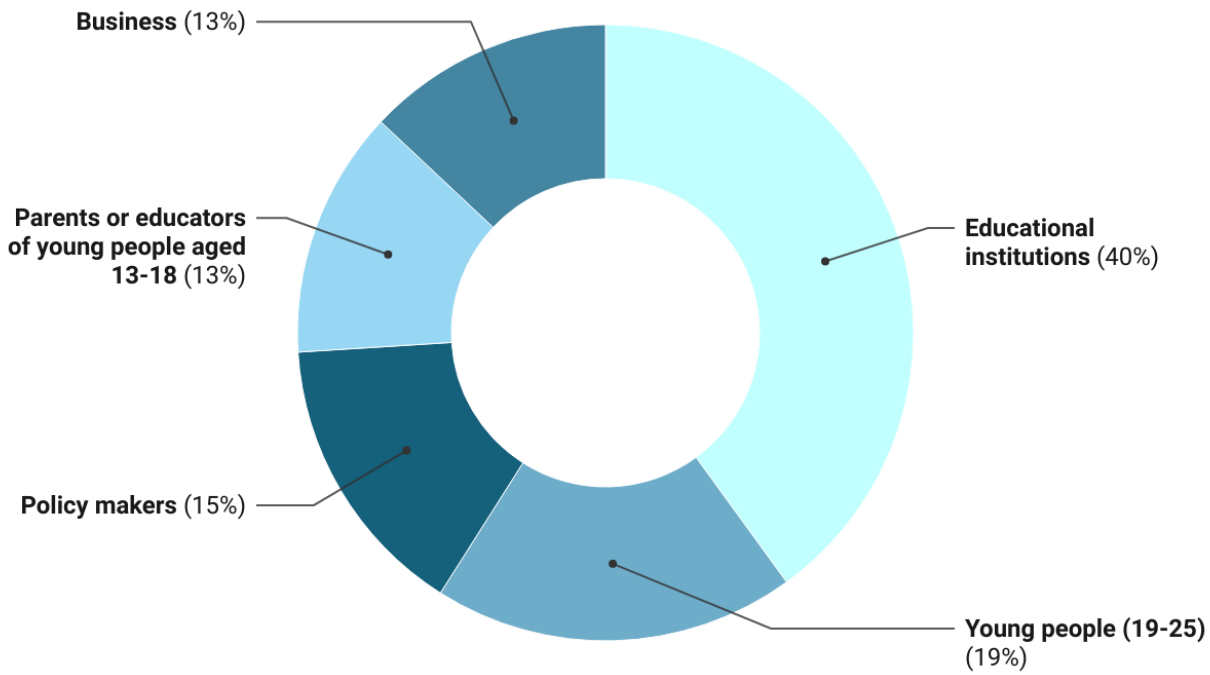

Figure 1: Interviewed target groups

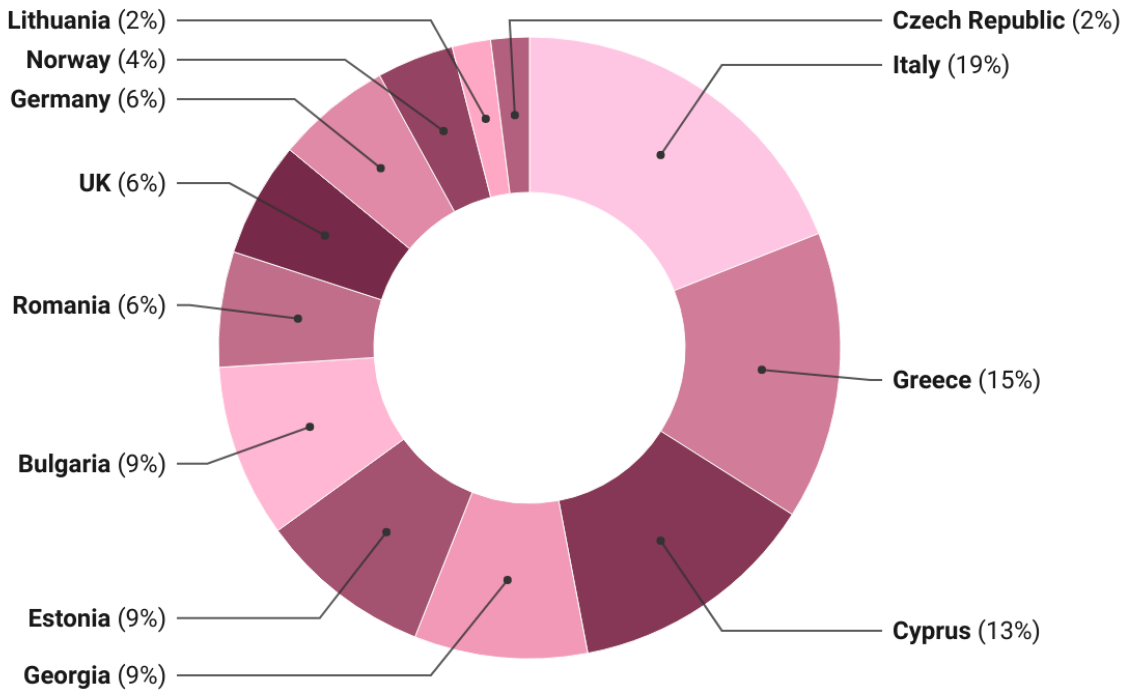

Figure 2: Geographical contexts of the interviewed stakeholders

Considering the factors and the goals mentioned above, a descriptive analysis was applied to the collected data using the following protocol:

- Data from Google Form have been downloaded.
- Graphs were generated to visualise the distribution of answers among target groups and countries. No differentiation based on the geographical context was applied to answers.
- Data sets made of answers were clustered for each question, and then for each target group, enabling the profiling of different target groups. It is important to note, once again, that certain target groups, such as policy makers and parents and educators of children 13 - 18, had fewer responses. Therefore, especially for those planning to develop STEAM laboratories targeting these groups, it is suggested to deepen and to conduct additional interviews to gain a more accurate understanding of their needs.
- Answers were interpreted and summarized using keywords (refer to Table 2 for a complete list of the keywords and their meanings). One or more keywords were assigned to describe each answer. This approach was chosen to capture the richness and complexity of the responses, but it should be acknowledged that this step may reflect the interpretation of the analysts reviewing the collected data.
- A quantitative analysis was conducted based on the frequency of the keyword in the answers revealing trends within the different target groups. A descriptive analysis of the results was carried out, considering the frequency analysis and the specific meanings of the keywords, complemented by a thorough reading of the answers.

Hereunder the analysis and interpretation of the results.

Participants answers reveal several common observations in all the interviewed groups. There is a strong emphasis on innovation, interdisciplinary integration, gender equality, and inclusion, which are consistently highlighted in all the collected answers. The specific characteristics associated with each group is described in the next chapter.

- Regarding question 1 about the **constraints of current scientific education**, the answers clearly indicate the teachers' need to adhere to textbooks and/or to curriculum guidelines plays a decisive role, leading to the adoption of passive and deductive teaching approaches in formal education. It is important to note that the lack of effective teachers' training in science education is also critical and this insight is congruent with the frequency of the keywords related to teachers' development and training in answers to question 5 which describes the benefits that SENSE. could bring. This result might derive from the fact that about 40% of the interviewed participants are from educational Institution, but

it still stresses the need for innovation and support. The availability of resources and integration among the different subjects/fields of knowledges are also two represented keywords in the answers to this question.

- Question 2, related to the **main barriers to participation, especially for girls**, presents a clearer scenario: in the answers, gender stereotypes and socio-cultural conditioning appear together with a frequency of 63%. Moreover, the lack of models for girls plays an important role from the point of view of the interviewed beneficiaries, although it should be highlighted that some stakeholders reported a perceived positive change in this aspect.

- Regarding the **useful strategies and approaches to promote inclusion and participation in science education** analysed in question 3, the two most frequent insights in the answers are the necessity of creating networks and implementing workshops with a strong interdisciplinary and hands-on dimension. The term "networks" assumes different meanings, such as teachers' networks, students' networks, and networks within the local community. Provided examples include inviting professionals to work with students at schools, organizing trips to interesting venues and visiting companies and sites of interest.

- Accessibility seems to be the greatest **benefit from the integration of science and arts** which constitutes the core point analysed in question 4. For the involved participants, the synergy between art and science may lead to a broader engagement and to a more inclusive teaching approach, allowing students to have ownership of their own learning path. Art and science are seen to effective means to discover and understand real-world phenomena offering multiple ways for students to approach facts and interact with different points of view. It is interesting to note that emotions and creativity also emerged from the answers: being creative should be a common feature in both scientific and artistic research. According to the interviewees, the emotional and sensual aspects should be present in scientific learning, even though it is not reported to be linked to it and considered crucial.

- Moving to question 5 on the **foreseen benefits from the completion of the SENSE. project** expected by the beneficiaries, in addition to the already mentioned support for teachers' development, interviewees emphasized innovation and new networking possibilities both at the local and European level as critical. There was an emphasis on the importance of making connections and being strongly innovative, open to listening and communicating. Furthermore, some answers pointed out the need for informal educational experiences and the integration of tools such as movies, TV series, storytelling.

- Answers to question 6 are related to **suggestions and hints for SENSE. development**. Interviewed participants emphasised the need for effective networks between institutions and local communities, schools, and families. It is also crucial to them to make an effort to communicate the results and to listen to the voices of the individuals, highlighting the benefits of a bottom-up approach. It was interesting to see some suggestions related to the broadening the target audience to include both younger and older participants.

In the following Table 2 and Figures 3, 4, 5, 6, 7, and 8, a description of the keywords used for the analysis of the answers and charts of the results are presented.

Table 2: Description of the keywords used in the stakeholders' answers analysis.

Keyword	Description
Accessibility	Possibility to have multiple points of view to access reality, possibility to access knowledge from different perspectives and backgrounds
Broader target	Suggestion to expand our target (both younger and older people)
Communication	Listening to people needs and interests, enhancing communication among people
Complexity	The need to address reality considering at the same time many points of view
Creativity	In the answers was related to divergent thinking, ability to think creatively
Critical thinking	Ability to approach critically reality and issues
Curriculum	The lessons and academic content taught at school
Digitalization	In the context of the answers, was related to digitalization of contents/materials (e.g., artworks)
Emotions	In the context of the answers, it refereed mainly to the ability to feel and to self-expression at an emotional level
Engagement	The engagement and interest raised in people (students, adults, etc.)
Equality	The possibility to have equal resources and starting points for the members of a society
EU-perspective	The need to have a more equal educational scenario in EU
Evidence	The possibility to show to students/people the good outcomes of the practices (e.g., of a particular educational strategy at school)
Finance	Economical resources
Flexibility	The possibility to change path, in particular the educational one
Good examples	Role models (for girls in STEM, or revolutionary historical figures) but also good practices
Hope	Feeling of hope towards future, linked to social and environmental issues
Inclusion	Inclusion of all kinds of people in society, with reference to minorities
Informal education	Informal education settings, non-conventional education form or sources (e.g., festivals, TV, TV series, novels)
Innovation	Drive towards change and progress

Integration	In this context, integration between the different field of knowledge, going “beyond the disciplines”
Knowledge	Knowledge in its broader meaning, both from formal and informal education
Lack of flexibility	The impossibility to change path, in particular the educational one
Network	The ability to create networks between entities (schools-families, schools-local institutions, among teachers, students)
Parents training	Increasing the awareness of parents and families on relevant issues (e.g. inclusion)
Playfulness	The enhancement of a playful attitude (e.g., in workshops, at school). Linked to engagement
Practice	The need for a more practical approach to education, more balanced with theory
Resources availability	Resources has a variety of meanings: space, laboratories availability, internet connections, availability of external educational resources (e.g., museums, science centres) in remote areas
Skills	Power skills (leadership development, the ability to integrate different kinds of knowledge, the flexibility, the critical thinking, problem-solving, personal development, wellness, time management among them)
Social media	Social media – mediated communication and culture dissemination
Socio-cultural conditioning	The conditions found in culture and family that may be interiorized by men and women (e.g., the responsibility to take care of children, housekeeping)
Stereotypes	The stereotypes in society linked to gender. STEM subjects related to boys, humanities and nursing jobs related to women
Students' demotivation	The lack of interest, engagement, and motivation among school students
Teacher training	Increasing the competence of teachers, both from a content (e.g., outdated knowledge) and a methodological point of view (e.g., more inclusive engaging and flexible approaches, less cohesion to textbook). Need to increase their motivation and their ability to offer a good professional orientation
Time	Time dedicated at school to the STEAM subjects
Values	Values related to personal growth and thus to richness of individuals and society. For example, the ability to formulate hypothesis, open-mindedness, ability to be flexible and to move and interact in different contexts and with different people.
Workshops	Hands-on workshops or thematic workshops. Both in the context of informal and informal education, targeting different groups (e.g., students, adults).

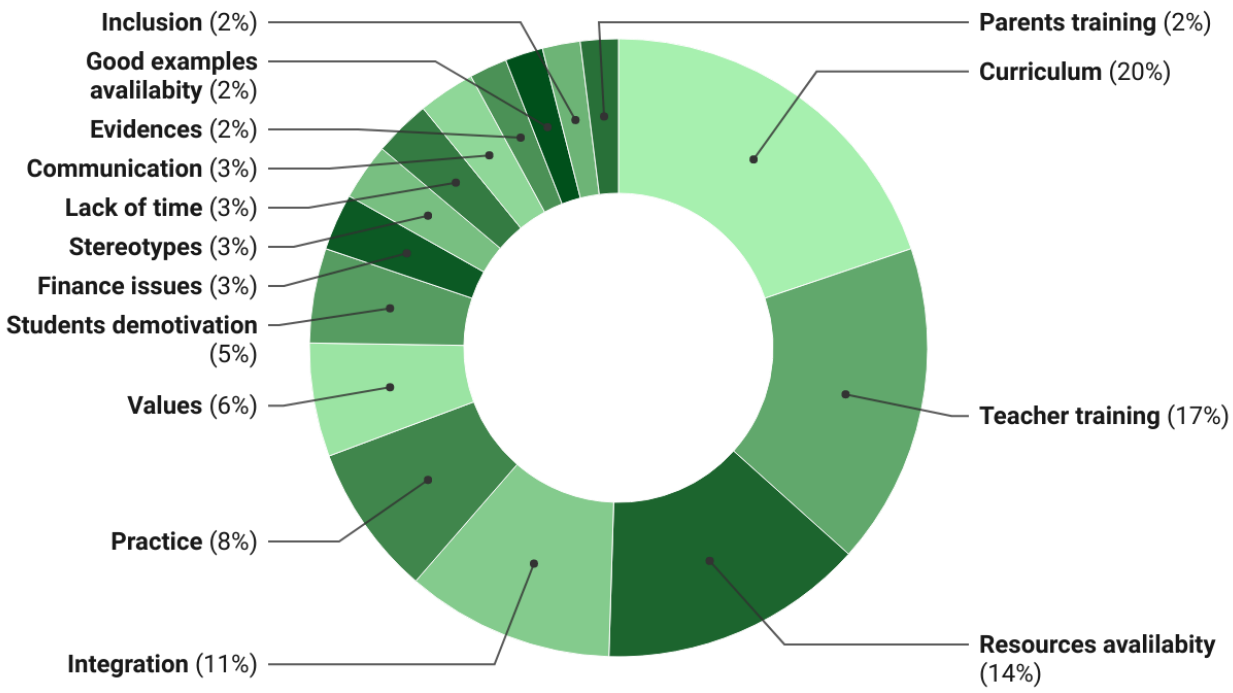

Figure 3: Frequency of keywords in constraints of current science education

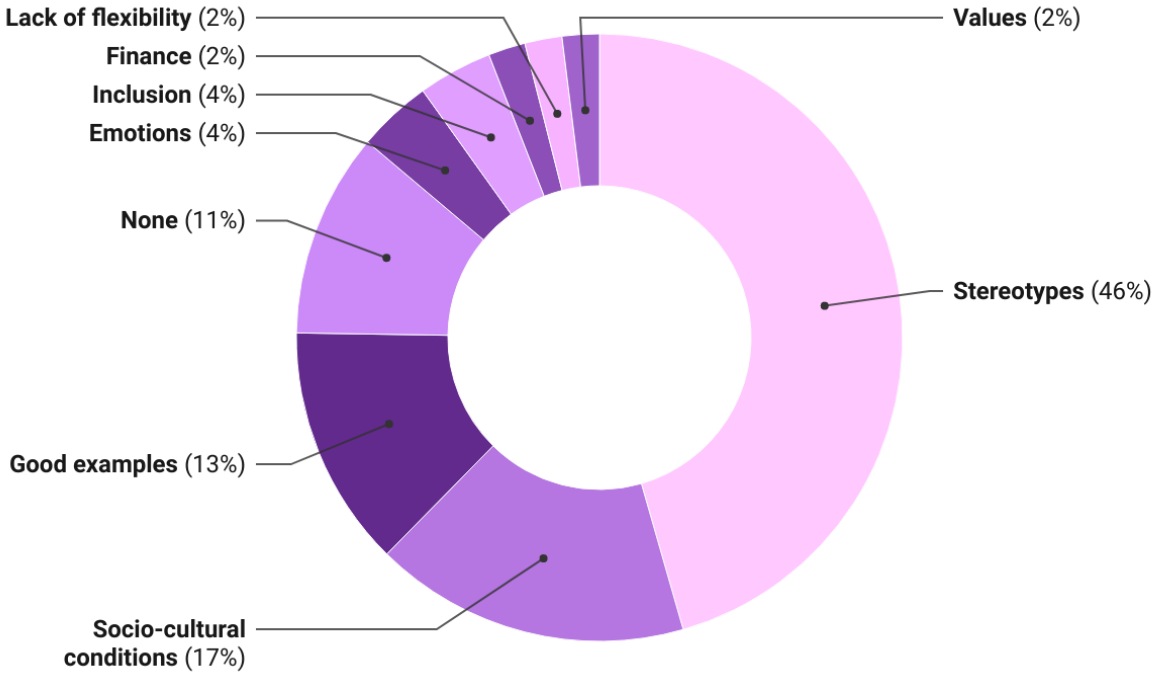

Figure 4: Frequency of keywords in barriers to participation of girls

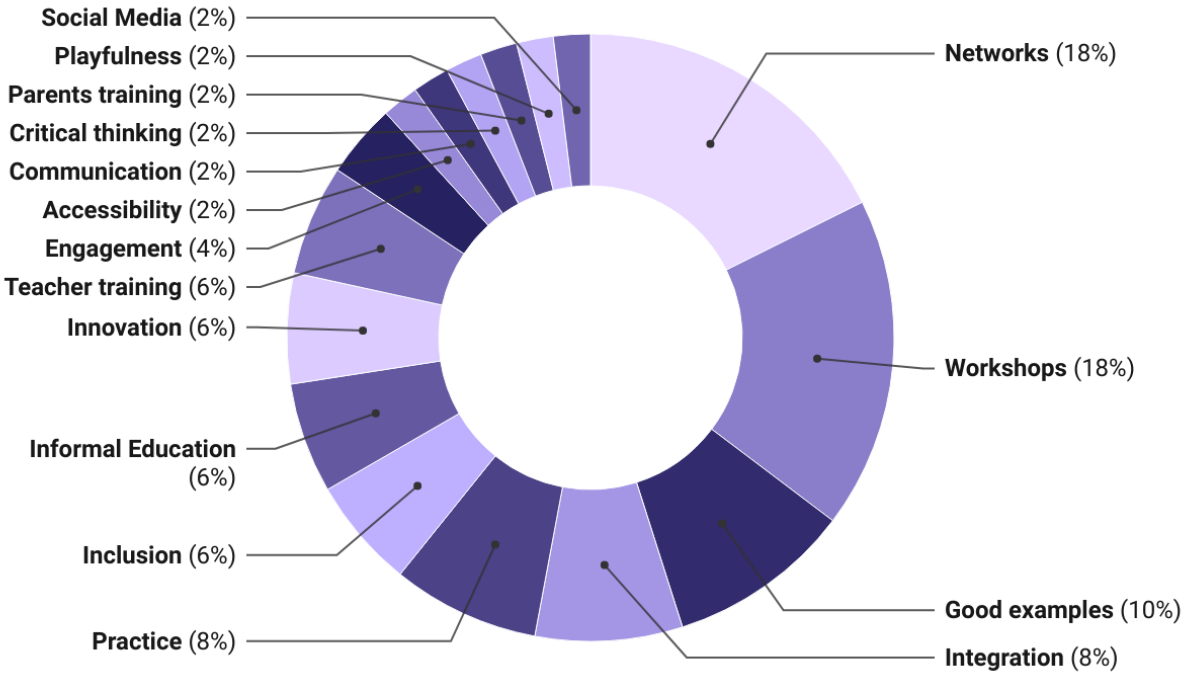

Figure 5: Frequency of keywords in strategies and approaches for inclusion in science education

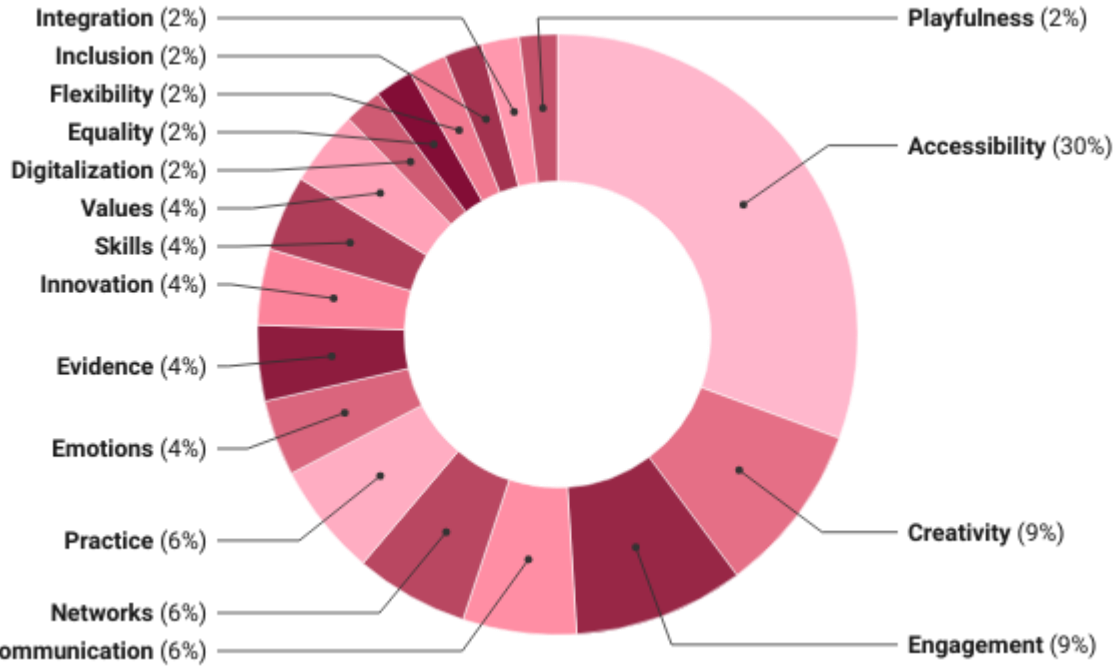

Figure 6: Frequency of keywords in integration of science and arts for STEM education

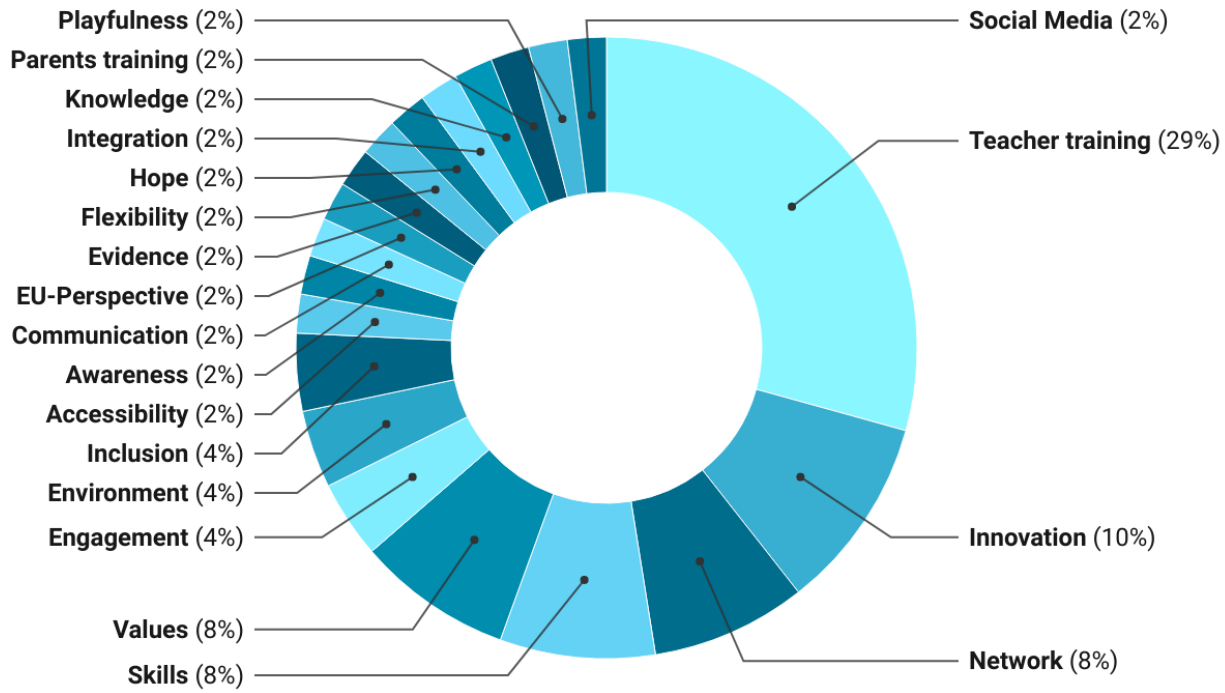

Figure 7: Frequency of keywords in benefits from the completion of SENSE.

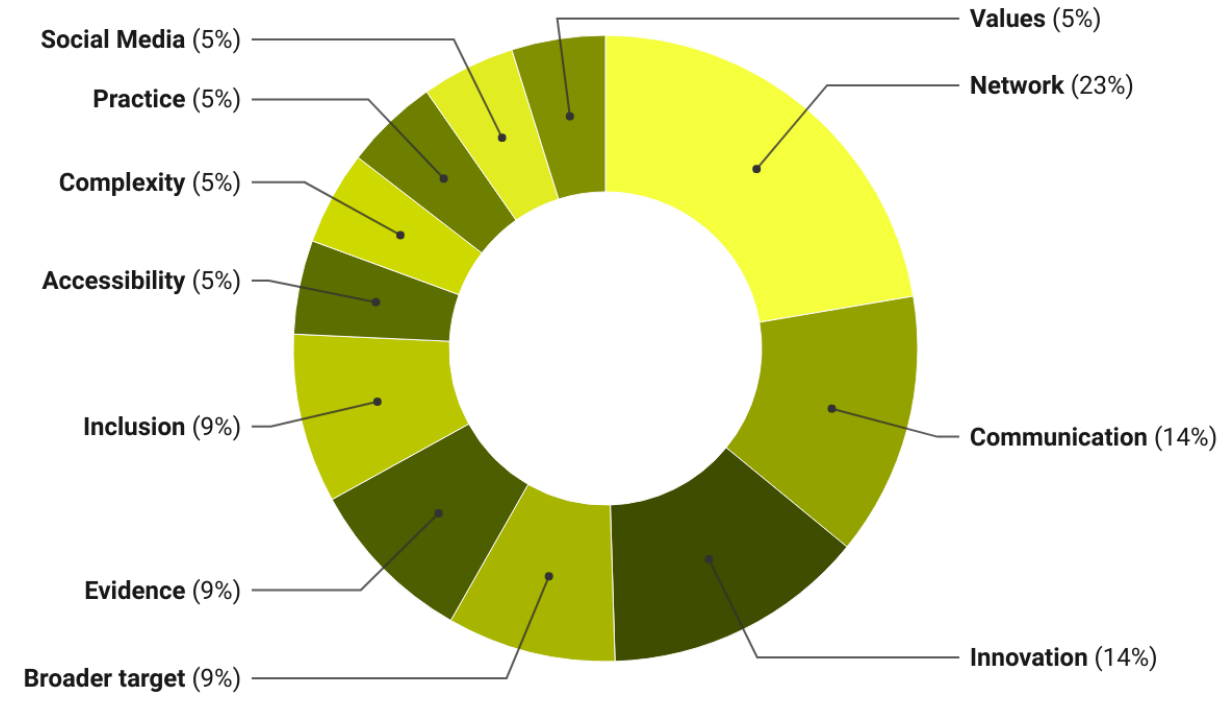

Figure 8: Frequency of keywords in suggestions for SENSE.

3.5. Key insights and take away points from the target groups profiles

This section presents specific features associated with each target group and provides a qualitative scenario for them. Interesting and distinctive perspectives have emerged from each target group, offering feedback on what is consistent or divergent within each group. This type of analysis doesn't consider the keywords' frequencies, that, considering the very small groups size, might not be significant, but it highlights feedbacks that are consistent or divergent in each target groups for future planning of the STEAM labs.

EDUCATIONAL INSTITUTIONS

The most represented group in our sample of interviewed participants, the educational institutions, demonstrates a **strong inclination towards innovation and the integration of different fields of knowledges**. This target group is interested in creating values such as accessibility and equality from SENSE. An interesting perspective emerged regarding the need to establish a **network between educational institutions and families to enhance the educational environment and propose an educational continuum**. The idea of offering workshops that go beyond traditional disciplines was widely present in this group, seen as a strategy to bridge the dichotomy between science and art and to facilitate real-world and authentic learning experiences.

BUSINESS STAKEHOLDERS

Regarding the business representatives, it is noteworthy that their focus and interest lie in the so-called '**power skills**' - leadership development, the ability to integrate different kinds of knowledge, the flexibility, the critical thinking, problem-solving, personal development, wellness, time management among others. They also highlighted how a **deeper understanding of humanities usually helps shape a more flexible mindset**, fostering the potentialities of the integration of the arts with scientific skills.

PARENTS OR EDUCATORS OF YOUNG PEOPLE AGED 13-18

Parents or educators of young people aged 13-18 did not deviate from the general scenario described in the previous paragraphs, but they offered additional insights into **social aspects** that SENSE. could address. For example, they suggest considering issues such as bullying that some girls may experience when engaging with certain contents or approaching specific groups. This aspect, along with reflections on "stereotypes", underscores the necessity of finding **new ways to address gender equality and social inclusion**.

POLICY MAKERS
Policy makers brought an interesting perspective on the **role of architecture in STEM** learning. Some answers mentioned how architecture and the act of building itself are activities that integrate many dimensions such as aesthetics and physics. Another interesting perspective from architecture is the **role of drawing as a mean of thinking and researching**.

YOUNG PEOPLE AGED 19 TO 25.
It is powerful to note that the word **environment**, a **strong urge for awareness** and a **sense of hope** were present in the answers of young people aged 19 to 25. A clear need for **innovation in education, communication and the creation of multicultural and inclusive networks** emerged from the interviews with the young participants. They emphasised the importance of **speaking up** and **being listened to**, with particular emphasis on the environmental issue. Interestingly, the term "social media" appeared only once in the interviews, despite a general need for **quality in content creation**, **engagement and scientific dissemination**, which was widespread in all their answers.

4. Conclusions

The findings and insights obtained from the stakeholder interviews and analysis have provided valuable information for guiding future work and shaping the project's direction. Building upon these findings, this section presents a list of take-away points and a set of recommendations for further work to enhance the effectiveness and impact of the project. Both these indications and these recommendations aim to address the identified needs and challenges, promote inclusivity, foster collaboration, and drive innovation in STEAM education. By implementing these recommendations, the project can ensure that the diverse perspectives and requirements of stakeholders are considered, paving the way for meaningful and sustainable advancements in STEAM learning.

4.1. Primary directives

Stakeholder participation is crucial for the successful development, implementation and long-term uptake of the SENSE.STEAM project and its roadmap. It will increase the effectiveness of the project, ensure that stakeholders' needs and expectations are addressed in an appropriate manner, ensure inclusiveness, engagement, participation, ownership, and sustainability. The stakeholder groups identified and interviewed include educational institutions, business representatives, parents, educators, policy makers, and youth. Effective communication about the concept of STEAM and its benefits for different groups is crucial for engaging stakeholders and ensuring the project success. In addition to personal communication, (social) media

and the digital hub will play a crucial role in spreading messages to inform and engage stakeholders.

The **needs and perspectives** of beneficiaries have been analysed through stakeholder interviews. The interviews have reaffirmed the importance of an innovative, integrated, and learner-centered approach in STEAM accordingly to almost all stakeholders. Building networks and facilitating communication between youth, parents, schools, educational institutions, employers, and policy makers are key priorities for stakeholders to learn and develop innovative and future-proof approaches. Inclusivity and overcoming stereotypes for equal participation are important topics that stakeholders would like to address. Teachers have identified the sturdiness of the curriculum as one of the main barriers to innovative and learner-centered education.

Stakeholder participation will be a central part of each STEAM Lab. Specific key messages need to be used to engage each stakeholder and generate spark and interest in the activities. A methodology for a thorough needs assessment as an integral part of each Lab is essential to be developed in WP4 to ensure a coordinated approach. The European Roadmap to STEAM education will have to facilitate effective networking between the Labs and the wider community to address the identified needs and barriers. Grassroot practitioners' views, needs and practices from the STEAM Labs will be functional to be brought to the policy level to co-formulate effective recommendations for local, national and EU level policy makers.

4.2. Recommendations for further work

Moreover, the following general orientation and work steps in the frame of the future STEAM labs in WP4 can be drawn for the next steps of the project:

- The qualitative material collected needs further **refinement** during the future Labs experiences.
- The limitations and barriers to participation and involvement in Arts & Sciences curricula should be more precisely defined for a **better and more robust classification**, distinguishing between **pragmatic and symbolic barriers**.
- The varying **levels of "illiteracy"** among stakeholders should also be investigated more deeply to account for them in terms of learning principles such as social, cultural, scientific, emotional principles for instance.
- The findings demonstrate that the diverse needs and expectations of different groups must be clearly considered as **dominant research processes** during the STEAM Labs, with a focus on improving teachers' experiences and capabilities, enhancing girls' self-representation in society, and offering innovative learning principles and activities for young adults.
- Developing a **common evaluation protocol** is essential in order to ensure the success of the STEAM labs.

5. References

Jaanso, A. (2019). Methodology for stakeholder engagement within the project Inter Ventures. The Association of European Border Regions (AEBR)

A guide for ensuring inclusion and equity in education, UNESCO 2017

6. Annex 1

6.1. Example of Presentation Letter

Dear Participant,

We invite you to participate in an interview for the European Project SENSE. Funded by Horizon Europe, the European Union's research and innovation programme.

The SENSE. project seeks to develop the 'New European Roadmap to STEAM (Science, Technology, Engineering, Arts, Maths) Education', addressing outdated perceptions of current science education as well as gender stereotypes by integrating educational approach based on sensorial inquiry, across the sciences and the arts. Space and Inclusion are two crosscutting themes in the project to recognise the value of an education that takes into account of local contexts and value the inclusion the different experiences of participants.

We will establish 13 'STEAM Labs' to develop and evaluate the 'SENSE. approach' alongside students, educators, teachers, businesses and other stakeholders.

The purpose of this interview is to identify important elements related to the challenges and the needs for SENSE. STEAM education to be considered in the project from the point of view of all the stakeholders taking part in the project.

Your responses will remain confidential and anonymous. Data from this interview will be reported only as a collective combined total. No one other than the interviewer will know your individual answers to this interview.

Your participation is considered as very important.

Thank you for your assistance in this research endeavour.

7. Annex 2

7.1. Google Form

SENSE Interviews – needs and challenges of SENSE target groups

Aim:
to ground SENSE. on the needs and perspectives of the various target groups of the SENSE project.

We ask you to complete this form for each of the person you will interview, reporting the answers you collected during the interview.

Data management:
The interviewed participants' data will remain confidential and anonymous. Data from each interview will be kept under lock and key by each organization and reported only anonymously here and elaborated in a collective combined total.

daniela.conti@creda.it Cambia account

*Campo obbligatorio

Email *

Il tuo indirizzo email

Who is writing? *

- ◯ HVL
- ◯ ODY
- ◯ PHW
- ◯ CREDA
- ◯ WECF

- ◯ LOUVRE
- ◯ H/B
- ◯ Velvet
- ◯ UB
- ◯ EFEE
- ◯ VilVite
- ◯ Trelleborg
- ◯ FBOFILL
- ◯ SHE
- ◯ PMC
- ◯ UEdin

Target group of the interviewed person *

- ◯ Young people aged from 19 to 25
- ◯ Educational institutions
- ◯ Business
- ◯ Policy makers
- ◯ Parents and/or educators of young people aged 13-18

What are the constrains of current science education in your context and from your point of view?

La tua risposta

What do you see as the main barriers to participation, especially for girls? *

La tua risposta

What strategies and approaches have you found useful to promote inclusion and participation in science education? *

La tua risposta

In what way do you think the integration of science and arts can improve STEM education of pupils from different backgrounds and contexts? *

La tua risposta

What benefits do you foresee for you or your organization from the completion of the SENSE project? *

La tua risposta

Do you have any suggestions for us? *

La tua risposta

Additional notes

La tua risposta

Invia Pagina 1 di 1 Cancella modulo

Non inviare mai le password tramite Moduli Google.

Questo modulo è stato creato all'interno di CREDA onlus. Segnala abuso

Google Moduli