

WP1 Coordination and support for dialogue and mutual learning

Deliverable D1.1 The Road-STEAMer participatory
methodology



Deliverable 1.1

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Abstract

This document presents the participatory methodology of the Road-STEAMer project. It constitutes deliverable D1.1 and is delivered in the third month of the project (M3). The participatory methodology constitutes the first output of the first Work Package (WP1 'Coordination and support for dialogue and mutual learning') as well as one of the very first deliverables of the project, aiming to inform all major strands of the work from early on. The overall aim of WP1, which horizontally spans across the whole project, is to enable and facilitate dialogue and mutual learning within and between the project consortium and the stakeholder communities, engaging individuals, groups and organisations in the processes and activities of the of the Road-STEAMer project. The participatory methodology defines appropriate means for this engagement, i.e. concrete ways in which consortium members and stakeholder community members will be enabled and facilitated to work together and exchange knowledge and views in the course of the project.

The participatory methodology details the activities to be organised by WP1, and, through this, also provides the framework for the development of collaborative and co-creative work in all other WPs of the project. Thus, it will inform the processes involving the consortium and stakeholders in dialogue, exchange and mutual learning in the following work strands:

- WP2 'STEAM context, concepts and conditions'
- WP3 'Analysis of STEAM policy gaps and needs'
- WP4 'The landscape of STEAM practices'
- WP5 'Synthesis of the STEAM roadmap for Science Education in Horizon Europe'.

Further, the participatory methodology as well as the overall efforts of WP1 to leverage consortium partners' networks and engage stakeholders in Road-STEAMer are aligned and synergistic with the relevant efforts for the communication, dissemination and exploitation of the project results (WP6 'Dissemination and Exploitation'), so as to bring the Road-STEAMer community in rich regular contact with the world beyond the boundaries of the project.

1 Introduction

This document presents the participatory methodology of the Road-STEAMer project. It constitutes deliverable D1.1 and is delivered in the third month of the project (M3). In this introductory section you can find some basic information on Road-STEAMer and the purpose of the participatory methodology within the project.

1.1 Road-STEAMer in a nutshell

Road-STEAMer is a 3-year (September 2022 – August 2025) Coordination and Support Action (CSA) of the Horizon Europe Programme of the European Union (EU) (Project number: 101058405; Call Topic: HORIZON-WIDERA-2021-ERA-01-70).

The project aims to develop a STEAM roadmap for science education in Horizon Europe (in short, the Roadmap), i.e. a plan of actions that will provide guidance to EU's key funding programme for research and innovation on how to encourage more interest in Science, Technology, Engineering and Mathematics (STEM) through the use of artistic approaches involving creative thinking and applied arts (the "A" in "STEAM"). The overall approach to the development of the STEAM roadmap is founded on the triangulation of the knowledge gained through stakeholder engagement, the analysis of STEAM practices, and the analysis of current educational policies, contexts and frameworks. The STEAM roadmap will be developed through:

- Collaboration and co-creation with stakeholders through intensive exchange, dialogue and mutual learning processes which will produce better knowledge and shared understandings of the relevant opportunities, challenges and needs
- A bottom-up approach emphasizing educational practice and practitioners' agency rather than high-level conceptualizations of STEAM and generic top-down plans or vague intention statements for its adoption in science education
- A specific focus on ways to leverage the power of STEAM approaches, as manifested through exemplary cases and best practices, in order to enable a bridging of open science and open schooling mentalities and practices which can catalyse an increased impact for science education as a crucial tool for addressing Europe's current scientific and societal challenges.

1.2 Key actors in Road-STEAMer

Key actors for the development of the roadmap are the members of the Road-STEAMer consortium, and members of a range of stakeholder communities, including the worlds of

school education, higher education, informal and non-formal science education, research, innovation, creativity, business, as well as policy makers and more widely citizens.

Road-STEAMer is implemented by a consortium of 12 partners from 8 countries across Europe:

1. The Lisbon Council (LC), Belgium
2. Ellinogermaniki Agogi (EA), Greece
3. Ecsite (EC), Belgium
4. TRACES (TR), France
5. University of Malta (UM), Malta
6. Politecnico di Milano (PO), Italy
7. Science View (SV), Greece
8. Zentrum für Soziale Innovation (ZSI), Austria
9. Engineering (ENG), Italy
10. Panteion University (PAN), Greece
11. European School Heads Association (ESHA), Netherlands
12. UNIVERSITY OF EXETER (UoE), UK

Central to the conceptualization of the project is the systematic collaboration of the above consortium with the communities of stakeholders for the co-creation of the STEAM roadmap.

Road-STEAMer identifies the stakeholders in the STEAM roadmap as follows:

- School education professionals and organisations (teachers, headteachers, teacher trainers, other school education experts, schools, school authorities, teacher training institutes, teacher and school networks, etc.)
- Higher education professionals and organisations (academics, university researchers, other higher education experts, universities, higher education authorities, etc.)
- Informal and non-formal science professionals and organisations (e.g. educators, communicators, other experts in science museums and science centres, after-school programmes, camps, festivals, clubs, etc.)
- Formal, informal and non-formal science learners and families (school education students, higher education students, informal/non-formal science education learners/audiences, young learners' parents)
- Research and innovation professionals and organisations (researchers, innovation actors, innovation experts, research organisations, research infrastructures, innovation centres, etc.)
- Creative industries professionals and organisations (designers, content creators, gaming experts, makers, creative industry businesses and institutions, etc.)
- Artists and arts organisations (theatre/dance companies, galleries, museums, etc), arts education professionals and institutions
- The world of entrepreneurship and business (businesspeople, companies, etc.)
- Citizens, civil society, NGOs and other third sector actors

- Education, research and innovation policy makers at various levels (from local to European).

1.3 Dialogue and mutual learning across Road-STEAMer

The participatory methodology constitutes the first output of the first Work Package (WP1 ‘Coordination and support for dialogue and mutual learning’) as well as one of the very first deliverables of the project, aiming to inform all major strands of the work from early on.

The overall aim of WP1, which horizontally spans across the whole project, is to enable and facilitate dialogue and mutual learning within and between the project consortium and the stakeholder communities, engaging individuals, groups and organisations in the processes and activities of the of the Road-STEAMer project. The participatory methodology defines appropriate means for this engagement, i.e. concrete ways in which consortium members and stakeholder community members will be enabled and facilitated to work together and exchange knowledge and views in the course of the project.

The participatory methodology details the activities to be organised by WP1, and, through this, also provides the framework for the development of collaborative and co-creative work in all other WPs of the project. Thus, it will inform the processes involving the consortium and stakeholders in dialogue, exchange and mutual learning in the following work strands:

- WP2 ‘STEAM context, concepts and conditions’
- WP3 ‘Analysis of STEAM policy gaps and needs’
- WP4 ‘The landscape of STEAM practices’
- WP5 ‘Synthesis of the STEAM roadmap for Science Education in Horizon Europe’.

Further, the participatory methodology as well as the overall efforts of WP1 to leverage consortium partners’ networks and engage stakeholders in Road-STEAMer are aligned and synergistic with the relevant efforts for the communication, dissemination and exploitation of the project results (WP6 ‘Dissemination and Exploitation’), so as to bring the Road-STEAMer community in rich regular contact with the world beyond the boundaries of the project.

2 Overall purpose of the participatory approach

The overall purpose of the participatory approach adopted by Road-STEAMer is to ensure that the STEAM roadmap which the project will develop will be grounded on shared knowledge and understanding among stakeholders of the relevant concepts, contexts, conditions, needs, and policy gaps in Europe's science education landscape, as well as of the opportunities arising through STEAM for integrated science learning approaches and synergies between school education, higher education, informal and non-formal science education, and the world of business, which will bring students and citizens in closer contact with Europe's big challenges. To this end, the participatory methodology paves the road for the development of the Road-STEAMer Stakeholder Community, which will consist of individuals, groups and organisations from different parts of Europe active in the worlds of school education, higher education, informal and non-formal science education, research, innovation, creativity, the arts, business, as well as the civil society, citizens and policy makers.

Further, the participatory methodology defines processes intertwined with all project work strands contributing the development of the roadmap, which will systematically engage members of the Road-STEAMer Stakeholder Community in active exchange, dialogue and co-creation with the consortium. More precisely, the consortium and the stakeholder community will synergize in the following work strands:

- *WP2 'STEAM context, concepts and conditions'*: A comprehensive analysis of STEAM concepts, contexts, and conditions, which will: a) cover the wider socioeconomic context and relevant needs in Europe; b) on this background, develop a comprehensive conceptual framework for STEAM covering its various aspects and potential; and c) analyse the various conditions and requirements for the effective adoption of STEAM approaches in education, such as those relating to the curriculum, teacher training, school organization, etc.
- *WP3 'Analysis of STEAM policy gaps and needs'*: Policy analysis to identify policy deficiencies and better understand needs for policy making, including: a) analysis of the existing policy context, including current educational policy initiatives such as the European Education Area and Erasmus, as well as centralised and independent outreach efforts, and considering links with other policy domains; b) analysis of previously funded projects and grass-roots initiatives; c) identification of gaps and overlaps or duplication of effort; d) recommendations for contributions to future policy actions.

- *WP4 'The landscape of STEAM practices'*: Analysis of the landscape of STEAM practices relating to secondary schools, tertiary education, and informal settings, focusing on the interplay of open science and open schooling approaches, reviewing existing STEAM projects with a European perspective to define the evaluation framework to be adopted, and performing action-research and participatory research activities on a subset of open schooling/open science activities to nourish and complete the survey with ad hoc observations.
- *WP5 'Synthesis of the STEAM roadmap for Science Education in Horizon Europe'*: Synthesis of the above work towards the development and delivery of the "STEAM Roadmap for Science Education in Horizon Europe" as a plan of action. In that regard, specific objectives are to involve formal, informal and non-formal science education, the world of business and synergies among them; focus on aligning STEAM education with society's and industry's expectations to prepare students to become active citizens and ready for the world of work; propose strategies and concrete actions to promote science education mainstreaming in funded projects in various EU policy domains.

At the time of formulating the present participatory methodology, the project has already started implementing this dialogic and co-creative approach by organizing structured exchanges for the development of a shared understanding among the consortium members towards the fine definition of the research goals and research questions of the work lying ahead. This progress, which also sheds light on the intended insights to be gained from the stakeholder community, can be summarized in the following general aim:

- *To support the European Commission to design science education policies that better connect secondary and tertiary science education, businesses and society, in a learning continuum, with STEAM as a vehicle, and in order to face Anthropocene challenges, through two main pillars:*
 - *The bridging of open science and open schooling*
 - *The use of creative thinking and applied arts.*

In this context, axes to be examined may include research questions such as the following:

- *How can the project develop a STEAM roadmap for science education in Europe that will provide guidance to EU's key funding programmes for research and innovation on how to encourage more interest in STEM?*
- *How can this be articulated through the use of artistic approaches involving creative thinking*
- *and applied arts (the "A" in 'STEAM')?*
- *How can this enable integrated science learning approaches and stronger connections between school education, higher education, informal and non-formal science education, and the world of business?*
- *How can the project achieve collaboration and co-creation with the stakeholder communities of science education, research, innovation and creativity, business and policymaking, through intensive exchange, dialogue and mutual learning among them?*

- *How will this produce better knowledge and shared understandings of the relevant opportunities, challenges and needs with relevant stakeholders?*
- *How can a bottom-up approach be used which emphasises educational practice, the real conditions at various levels of the education system for the effective introduction of STEAM, and practitioners' agency rather than high-level conceptualizations of STEAM and generic top-down plans for its adoption in science education?*
- *How can the power of STEAM approaches be leveraged, as manifested through exemplary cases and best practices, so as to enable a bridging of open science and open schooling which can catalyse an increased impact for science education as a crucial tool for addressing Europe's current scientific and societal challenges?*
- *How can the framework of design training methodology (project-based learning with studios) be applied to STEM disciplines, to better contextualize students' learning, improve team work and communication skills, and increase learners' motivation and readiness for the job market?*

3 Co-created methodology building on good practice

The participatory methodology has been defined collaboratively within the consortium in accordance with the project objectives, and on the basis of partners' existing relevant expertise and experience. It builds on a review of good practice from successful projects and initiatives, including several to which consortium members have direct access. It is the result of collaboration and exchange across the consortium at the outset of the project, ensuring that the participatory approach it offers will be applicable and workable in the context of each of the participating countries, by each of the participating organisations, and in alignment with their roles and expected contributions.

The following sections summarise the main approaches, methodologies and practices reviewed, which will be used for inspiration and as examples of good practice in the design and development of the participatory activities in Road-STEAMer.

3.1 Engaging school communities

The engagement of school communities in the processes of Road-STEAMer will build on rich recent and current experience gained through the development of the networks of schools involved in two open schooling projects: Open Schools for Open Societies (OSOS)¹ and

¹ <https://cordis.europa.eu/project/id/741572>

Schools as Living Labs (SALL)². This expertise is brought into Road-STEAMer by EA, as the coordinator of both these projects, as well as by other partners involved in them (LC, EC, TR, SV, ESHA).

OSOS³ has described and implemented at scale a process which facilitates the transformation of schools into innovative ecosystems, acting as shared sites of science learning for which leaders, teachers, students and the local community share responsibility, over which they share authority, and from which they all benefit through the increase of their communities' science capital and the development of responsible citizenship.

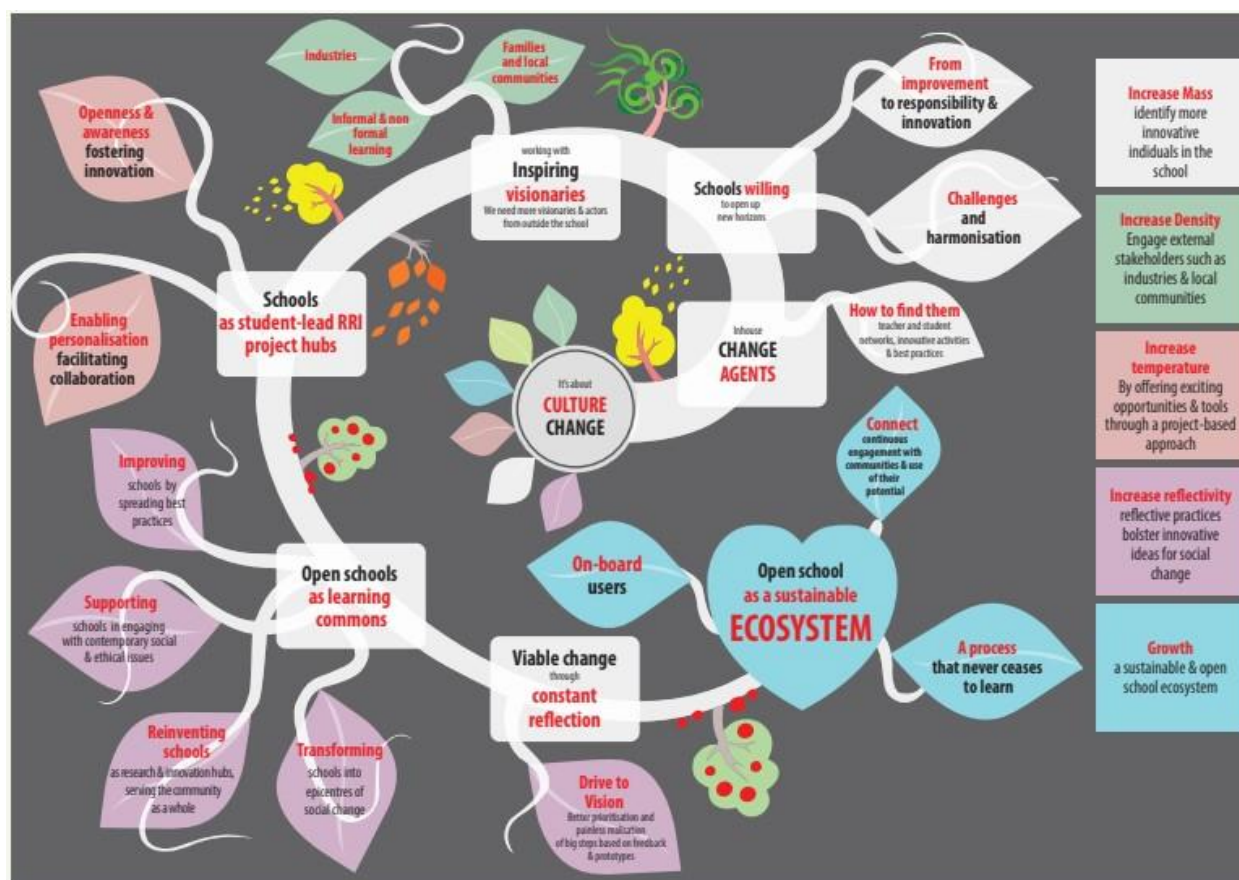


Figure 1: The full cycle of school transformation proposed by OSOS.

The project has proposed the Open School Model⁴, which provides school leaders with a framework that can help them with the transformation of their school into an open school. This

² <https://cordis.europa.eu/project/id/871794>

³ <https://www.openschools.eu>

⁴ <https://www.openschools.eu/open-school-model>

transformation can only take place if a school does not isolate itself but opens up to other schools. Schools can form a hub together, in which they help each other, collect good practices and share their experiences. Such an open and curious environment will support the development of innovative and creative educational activities. The model takes school settings into account and therefore ensures that school leaders can innovate in a way that is pleasant and suitable for schools. The process starts with Change Agents who become Inspiring Leaders of the school community. Along the way, the OSOS support mechanism supports school leaders to capture innovation and decide on the appropriate strategy to diffuse innovation in the school, with constant reflection as part of the process, and guides them towards the transformation of the school into an Open Schooling Hub and eventually to a sustainable innovation ecosystem (Figure 1).

The participatory activities in Road-STEAMer will be developed on the background of lessons learnt in OSOS, in particular as reflected in its Open Schooling Roadmap, which provides an overview of the implementation of open schooling approaches.

Building on the background of OSOS, SALL⁵ proposes the methodology of Living Labs as a new, specific technique for the development of open schooling activities linked to science learning in Europe's schools, adding significant value for open schools as well as for science learning and its position and roles in contemporary societies. In this approach, students together with societal actors co-create solutions to current challenges they choose to address, thus realising the vision of opening schools to society and turning them into agents of wellbeing in their local communities.

Based on a strong participatory approach, the project interweaves dialogue and mutual learning processes with its work for the co-creation, implementation and evaluation of the SALL methodology. Core elements of this are the active engagement of school communities as well as an array of project community and dialogue events. Being the central players in SALL, school communities are systematically engaged in the work of the project, including teachers, students, students' families, and more broadly the schools' local communities.

To help achieve the ambitious goals of Road-STEAMer for wide stakeholder engagement, the consortium will draw on the sizeable and sustained networks of more than 1,500 school communities across Europe that have been developed by OSOS and SALL. By the time of the

⁵ <https://www.schoolsaslivinglabs.eu>

formal completion of OSOS in 2020, the project had managed to create, and EA is still sustaining and facilitating, a network of 1,169 schools which were introduced to the open schooling concepts and practices and have been developing rich open schooling activities across Europe.

In addition, SALL is currently engaging 412 school communities, including at least 1,000 teachers and at least 10,000 students and their families, in living-lab based open schooling activities in ten countries representing a wide variety of geographical, national, cultural and socioeconomic contexts (Figure 2).

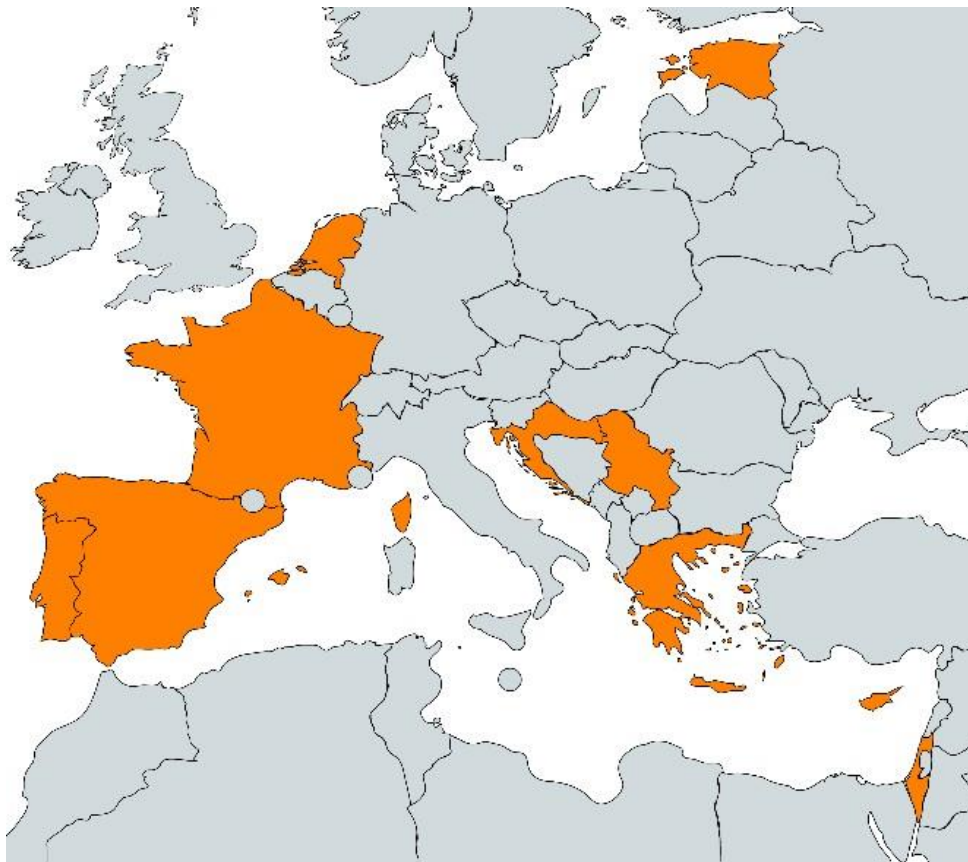


Figure 2: The ten countries of the school communities participating in SALL

SALL is actively developing and maintain this community of schools though information campaigns, invitations for collaboration, various incentives for active engagement (e.g. playful engagement design of the activities, contests with various prizes including teachers' and students' participation in European events), as well as continuous support and teacher training opportunities. This is centrally managed by EA, as the project coordinator, in close

collaboration with consortium members who act as the National Coordinators of school activities in their respective countries, managing them in accordance with the local circumstances, possibilities and requirements.

While SALL will be completed at the end of August 2023, its consortium and EA as the coordinator are committed to maintaining and expanding this network of schools. Road-STEAMer has from early on sought ways to link its participatory activities to those of SALL, and synergies between the two projects are being designed to make best use of the mature dynamics already developed in the ecosystem of SALL. On the one hand, the consortium will be drawing on the SALL network of schools to identify, invite and engage school communities and other relevant stakeholders in Road-STEAMer. In addition, the project will particularly focus the synergistic efforts on the dialogues and policy road-mapping activities culminating in SALL in its final year (organized by EA, LC, and EC), as those bear similarities in the approach and partially share common thematic ground with relevant activities in the first year of Road-STEAMer (September 2022-August 2023).

Finally, OSOS and SALL can offer their digital community spaces as well as their European-level teacher training initiatives as useful vehicles for the purposes of Road-STEAMer. Both the OSOS Portal and the SALL Community Platform, which are available under the School of the Future portal⁶, can be used by Road-STEAMer to promote its access to school communities. Further, both OSOS and SALL regularly develop European teacher training initiatives under the scheme of European School Innovation Academy (ESIA)⁷, which can constitute useful frameworks for the co-organisation of participatory processes and events. EA will facilitate the exploitation of these opportunities by Road-STEAMer when and as useful during the project.

3.2 Bottom-up community engagement in policy design

An example of using co-creation methodologies combined with a bottom-up design-driven approach for community engagement in policy design comes from the SISCODE project. This expertise is contributed to the Road-STEAMer consortium through several partners (EC, TR, PO).

⁶ <https://www.schoolofthefuture.eu>

⁷ <https://esia.ea.gr>

SISCODE was an EU-funded project which aimed at stimulating co-creation in policy design by using bottom-up design-driven methodologies to pollinate Responsible Research and Innovation and Science Technology and Innovation policies.

SISCODE⁸ provides a rich set of resources in which the Road-STEAMer community can find inspiration and useful ideas for the development of its activities. Of particular usefulness may also be the various tools which have been developed or applied during SISCODE. For each tool there are instructions and practical tips on how to use the tools itself, in which phase of the process/workshop they can be applied, and which benefits are to be expected. Of particular interest in relation to the participatory methodology of Road-STEAMer are the tools used in SISCODE for stakeholder engagement. An additional useful resource is also SISCODE's toolkit for the conduction of policy workshops.

Among the many ideas and resources members of the Road-STEAMer community can draw from SISCODE, there are also practical ideas for creating an interactive and engaging experience for the participants of the various project community events of Road-STEAMer. Such ideas can be found in the 'Activities pool for co-creation labs open days'. The activities presented are 12 ice-breakers, 14 dialogue activities and 9 engagement activities, as summarized in Table 1.

Table 1: Ideas for creating interactive and engaging experiences from the SISCODE project

| Ice breakers | Dialogue activities | Engagement |
|---|---|--|
| Name circle Back to back drawing Birthdays - silent icebreaker Embarrassing introduction Ball throwing game Geographical locations Unusual fact True or false Sli.do (or similar tools) | Science Espresso World Café Reversed Science Café PlayDecide Games Science Speed Dating On the Bench Video synthesis Dixit 2.0 The ill-fated tribunal (role play) Discussion continuum Priority game Moving debate The 7 whys Seeing through art | Journal Mapping Doll scenarios Problem Tree Lego Play Lotus Flower Experiment mixtape Mini-campaign challenge Transforming Objects Empathy Map Photovoice |

⁸ <https://cordis.europa.eu/project/id/788217>

3.3 Event formats for stakeholder engagement

Ideas for the organization of inspiring events with the engagement of different stakeholders are also drawn from the SPARKS project⁹, which is connected to Road-STEAMer through EC and EA.

SPARKS was an engagement project on the topic of technology shifts in health and medicine, which raised Europeans' awareness that they can get involved in science and that various stakeholders share the responsibility for scientific research and innovation. Road-STEAMer can utilize various event formats proposed by SPARKS, such as Science Espressos, Reverse Science Cafés, Pop-up Science Shops and Scenario Workshops.

A useful resource offered by SPARKS is the 'SPARKS Toolkit'.¹⁰ This is an easy-to-use guide helping identify the activity that best fits objectives and resources for any given event, and appropriately organize Science Espressos, Reverse Science Cafés, Pop-up Science Shops or Scenario Workshops. It is a playful tool to choose and implement successful participatory activities engaging citizens and multiple stakeholders in the practices of Responsible Research and Innovation (RRI). The Toolkit can help members of the Road-STEAMer consortium to understand the differences between the types of formats in terms of resources and engagement level, offering practical advice on developing the most suited ones, and providing examples of how to deal with the topic of RRI through public engagement methodologies.

A visual summary of the characteristics of the four event formats from the SPARKS project are provided in Figure 3.

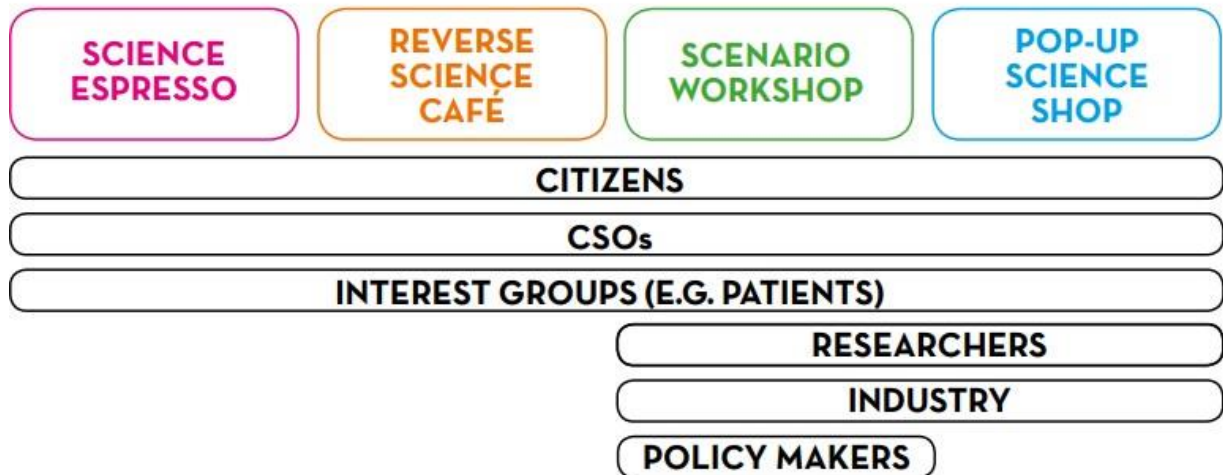
⁹ <https://cordis.europa.eu/project/id/665825>

¹⁰ <https://www.ecsite.eu/activities-and-services/resources/sparks-toolkit>

Depth of engagement



Who is in the audience?



Number of participants:



Time needs:



Figure 3: A visual summary of the characteristics of the four event formats from SPARKS.

3.4 Living dialogic spaces via creative learning conversations

Useful ideas for the organization of stakeholder workshops in Road-STEAMer can be drawn from the CREATIONS project¹¹. The workshops designed by UoE in that project drew on the idea of creating a living dialogic space via creative learning conversations in which all participants are listened to and have a voice.¹² This approach was used in order to model the kind of facilitation and pedagogy that the CREATIONS project itself was aiming to encourage, working to the following principles: partiality, emancipation, working ‘from the bottom up’, participation, debate and difference, openness to action, and embodied and verbalised idea exchange.

A similar approach applied to Road-STEAMer would be fitting as the two projects share a common aim of opening creative space for stakeholders to offer opinions. It is advisable that any workshops contain a digital recording sheet which can be filled in online as stakeholders complete tasks, in order to document responses. Photographs of activities were also used to document creative tasks used to share ideas.

Table 2 below shows examples of the kinds of activities and facilitation structures that can be used to bring these principles to life to create living dialogic spaces. Further details can be found in the relevant Workshop Guidance documentation from CREATIONS, which is included in the Annex to the present document.

Table 2: Examples of activities and facilitation structures for creating living dialogic spaces

| Activity | Purpose |
|---|---|
| <p>Icebreakers: Introduce yourself and say ONE sentence each about your role in relation to STEAM education.</p> <p>Temperature taking: See the middle of the table/screen as very hot/positive and the edge of the table/screen as very cold/negative. Place your hand on the table/screen in terms of how positive/negative you currently feel about the state of STEAM education. Briefly share your reasons for where your hand is.</p> | <p>Introduces stakeholders’ backgrounds and creates opportunity to share opinions, in a fair space, where all have a voice. Emphasis on physicalisation of ideas rather than always being dependent on words which reflects STEAM approach beyond the word.</p> |

¹¹ <https://cordis.europa.eu/project/id/665917>

¹² Chappell, K., & Craft, A. (2011) Creative learning conversations: producing living dialogic spaces. Educational Research. 53(3) p363–385.

| | |
|--|--|
| <p>Dialogue around core questions: e.g. What is STEAM or How can STEAM be developed through the use of arts-based activities, creative approaches and open-science/schooling?</p> <p>Whatever the key terms in the question are, small groups are provided with prepared lists of statements of definitions of terms. They are asked these to rank or represent these in space to trigger a discussion as to their importance and value within the STEAM dialogue. Online this could be in Padlet. If face-to-face, this can be done with slips of paper on the table top. An opportunity is also provided for stakeholders to offer 'missing points' or to remove points that they don't feel are relevant. Documenting key discussion points as they go.</p> | <p>These are used to focus the participants into the area that the partners are interested but offer space for dialogue as to what is most important to those stakeholders.</p> <p>The 'missing points' part of the task also allows stakeholders to bring in their own perspective around elements that Road-STEAMer consortium partners may not have considered.</p> |
| <p>Share good/best practice in smaller groups, documenting as they go.</p> | <p>With application of Road-STEAMer criteria ultimately part of the project this space to share professional cases from stakeholders and to critique them in terms of how they offer good/best practice is important.</p> |
| <p>Creative drawing exercise to create a roadmap: This is an example of the kind of exercise that might be undertaken but the point is to emphasise a drawing exercise as a means to conversational development of the points in hand.</p> | <p>Talking and drawing has been demonstrated to be a useful way to tease out deeper explanation and understanding in interviews and focus group situations like this. It allows for more 'space' in the debate and time to think whilst drawing. If workshops are online, Mural would be a helpful space which has drawing options and would allow participants to collaboratively create a roadmap or other drawing together.</p> |
| <p>Wrap up: Thank all participants for their contributions. In a circle or arrangement where everyone can see each other's faces ask all the participants to offer one word summing up how they have felt about the workshop, and one sentence saying what they will take away from it.</p> | <p>This keeps the two-way communication open between stakeholders and project partners and keeps 'the door open' for future conversations as to how they can take on Road-STEAMer recommendations etc. in their own work.</p> |

3.5 Other approaches to engagement in science and STEAM

Drawing on Road-STEAMer partners' extensive experience in this field, the consortium has also reviewed a considerable number of other practices that emphasise stakeholder

engagement in science and, particularly, in STEAM. While several of those practices will be analysed in detail in the context of WP4 'The landscape of STEAM practices', it is worth mentioning here some which consortium partners have identified as useful sources of information and inspiration for the development of the participatory methodology and the stakeholder community activities of Road-STEAMer.

3.5.1 Famelab science communication workshops and competition

A science engagement format with potential interest for the participatory processes of Road-STEAMer is Famelab, experience in which is brought into the project by PAN. Famelab is a science communication competition for undergraduate students and alumni of science, engineering, and social science schools. The aim of the participants is to explain a scientific topic in three minutes, without using presentation aids such as PowerPoint slides, but only objects (props) related to their subject. Contestants are judged on creativity, content, and charisma. Local winners go on to participate in Famelab International, which at its peak, included scientists from 33 countries. The competition is organised by the National Endowment for Science, Technology and the Arts (NESTA) in the UK, but its international success can be attributed to their cooperation with British Council and its local departments. A major part of its outreach impact has to do with the local communities of science communicators, many of which are active on YouTube, podcasts or face-to-face events.

3.5.2 The co-creation approach of SciCultureD and CourseKit

SciCulture and SciCultureD are two Erasmus+ projects, experiences from which are contributed by UM and SV. The two projects ran a 5-day intensive course that brought together professional and student scientists, artists, educators and entrepreneurs to develop project ideas and societal actions that address European Green Deal and the Sustainable Development Goals.

SciCultureD uses Design Thinking and innovative pedagogies to nurture collaboration between disciplines and to bring people of different backgrounds together. It brings together social enterprise, scientific research, and the arts. The course uses a transdisciplinary and collaborative approach to do so.

The original programme, SciCulture, created the toolkit called CourseKit which was created as a playful tool for educators and course developers. The card game and board helps to design courses that bring together people from different disciplines while challenging them to work together to address challenges. These courses can range from a 2-hour workshop to a

semester-long course, to even a whole masters. The toolkit is very flexible and is meant to be a space that brings people from all backgrounds together to creatively co-create.¹³

3.5.3 Science and Arts festivals as a platform for stakeholder engagement

Science in the City is Malta's Science and Arts festival, now running for 10 years, and has grown an audience of over 30,000 visitors. By 2019, an independent survey had identified over 40% of the population having attended the festival, or over 200,000 people. The festival takes a creative, interactive, artistic approach to science communication. Every year hundreds of researchers, organisations, artists, students, industry representatives, government employees and others engage people in Malta with research in subjects across the STEAM areas, and other fields. The festival provides schools, educators, and other stakeholders an opportunity to showcase and engage thousands of people with their work. Examples include school children performing in theatres after developing their productions with artists and researchers (the Learning through Theatre approach), youths who worked with dancers to reconnect with nature through performance arts, local researchers and artists who developed animations and workshops to engage publics about local biodiversity, artistic street art and interactive installation art developed in conjunction with local researchers, music co-created by researchers and musicians, and a plethora of community groups that have showcased their projects through the festival. The approach of Science in the City can be used to engage audiences meaningfully and effectively.

3.5.4 Game Jams as open and inclusive game design and development events for STEAM education

Another practice contributed by UM with interesting potential for the engagement of young stakeholders is game jams. Game jams are game creation events where the participants, the "jammers", create a game, usually in small teams, based on a given central theme, within a short time. They are defined as "accelerated opportunistic game creation events where a game is created in a relatively short time-frame exploring given design constraint(s) and end results are shared publicly." They have grown in popularity over the past few years and garnered the interest of the academic community in terms of the technical creation, as well as on the emerging social and educational dynamics.

Digital games are widely used in informal and non-formal learning settings, such as after-school programmes, science fairs, and game jams in order to support learning goals and often

¹³ <https://scicultured.eu/resources/coursekit>

resulting in the emergence of “communities of practice”. The game jam format has been described as an effective approach to include in the game development curriculum as well as an effective way to teach the game design process. Implementation of game jam elements in the curriculum such as work in teams with members of different ages and diverse skills and experience, a game theme, limited time, and support from professional game developers, lead to better understanding of game elements, design, development, and production. Increased learning outcomes may be observed even when game jams are part of the extracurricular activities of conventional courses. Instead of involving only game designers and following the structured and linear process of the traditional game design educational approach, games jams are more inclusive, allowing diverse opinions, backgrounds, areas of expertise, and a more iterative and intuitive process which could lead to innovative outcomes.

Beyond training and professional development, the learning processes, the skills, and the competences emerging in game jams, are also being considered in the context of formal and non-formal learning settings, even for students who are not pursuing a game development-oriented education. Previous studies have argued that game jams can be environments where the interdisciplinarity and the acquisition of knowledge and skills may foster “informal STEM learning”, as well as social and communication skills. The Global Game Jam NEXT®, the version of the Game Jam for younger participants, in the 12-17 age bracket, has explicitly listed developing STEAM skills in its objectives, citing its effectiveness as a learning venue and its ability to stimulate innovation and creativity. Knowledge, competences, social skills such as communication of ideas, networking, making friends, and engagement in conversations, STEM related skills in areas such as Mathematics, Programming, and use of complex technological game development tools seem to improve during a game jam and have been studied in the framework of formal primary and secondary education, and as informal learning environments. Interest in the creative aspect of the game jams has also increased over the past few years. For example, the abstract theme of the Global Game Jam®, the diversifiers, voluntary additional constraints, and the lack of prizes, may inspire creativity, increase diversity of final outcomes, and reduce stress, conflict, and risk-aversion which can deter creativity. The accelerated pace, the limited time, the challenges and design constraints, the collaboration with unfamiliar people, may further require flexibility, and creative and novel ways to approach a task.

Furthermore, the values shared by the game jams have been linked to the potential for social change. Values such as the participatory approach, the co-creation and collaborative environment, the inclusiveness and openness to all, and the continuous cycle of reflection and action have been compared to approaches such as the participatory design, and the Participatory Action Research methodology where all sides involved, all stakeholders, participate from the beginning of the project and contribute to the design of the process, the questions asked, and the final outcomes. The innovation and value of game jams lies in not only the artefacts developed and shared with the community, but also in the open and inclusive processes followed.

3.5.5 Engaging school communities in STEAM approaches

In the context of co-creating the participatory methodology, the consortium has also reviewed existing methods and good practice for engaging school communities in STEAM approaches, which is naturally expected to form part of the stakeholder engagement activities of Road-STEAMer. The reader is reminded that such practices will be analysed in detail in the context of WP4 'The landscape of STEAM practices'. The examples mentioned below are indicative and serve the purpose of informing and inspiring the development of stakeholder engagement activities specifically linked to STEAM.

Useful relevant input can be drawn for example from the NEXT STEP project¹⁴, experiences from which are contributed by SV and EA. NEXT STEP provides well-tested tailor-made solutions in skills development and inclusion through creativity and the arts, proposing an effective operation of the "creative and innovative school". The NEXT STEP vision for a creative and innovative school is the development of the creative and innovative classroom of tomorrow, the STEAM IDEAS' Square, in which education relies on an interdisciplinary, arts-based methodology within an entrepreneurship and design thinking framework.

The project is adding its contribution to the current efforts of a creative and innovative school by focusing on two key areas that could support the realization of suitable initiatives in every single school:

- NEXT STEP is implementing a whole school approach to learning by supporting schools' capacity to work with external organizations so as to explore how such partnerships and networks can be built through a long-term strategy-based on trust and common objectives and how they contribute to key competence development. Teaching science in the context of the arts, humanities and social sciences is recognised as an important learning aid.

¹⁴ <https://www.the-next-step.eu>

There are numerous innovative initiatives in the field (e.g., the Global Science Opera¹⁵, the Learning Science Through Theater¹⁶) that have the potential to increase students' achievements in key competences. Collaboration amongst teachers is one of the key features of NEXT STEP whole school approach, which aims at creating inclusive learning environments that foster competence development for all learners.

- NEXT STEP is going a step further by setting up a roadmap for the transformation of the school classrooms to creative and innovative learning spaces: when thinking about the (re)organisation of a classroom and which pedagogies to use to promote a creative and innovative school, thinking out of the box is the key to success. In this framework the NEXT STEP project designed and set in operation the STEAM IDEAS' Square, an innovative learning environment which is the nucleus of the school's creative and innovative activities.

To support schools in this "journey", NEXT STEP created and operates a Self-Reflection Tool to measure the status of each school concerning their level of integration of STEAM Approaches. The tool is available¹⁷ and any school can join. After self-reflection the school is guided, according to its status, and specific strategies and activities are proposed, tailor made for the specific school.



Figure 3: A graphical representation of the STEAM IDEAS' Square, i.e. NEXT STEP's vision for the open school classroom, where science education will be taught using an interdisciplinary methodology via arts activities and the integration of other disciplines such as entrepreneurship and design thinking. This environment transfers the research and science lab experience in the classroom helping students develop key competences and skills. Students and

teachers collaborate with external stakeholders that contribute, according to their field, to the Open School projects. The STEAM IDEAS' Square is the meeting point of students, teachers, artists, entrepreneurs, researchers as well as the local community representatives to collaborate, work together and propose solutions for the community's well-being.

¹⁵ <https://globalscienceopera.com>

¹⁶ <http://lstt.eu>

¹⁷ <https://srt.the-next-step.eu>

As further example, the Learning Science Through Theatre (LSTT)¹⁸ initiative aims to engage students in order to develop and perform their own performance based on a scientific concept. The initiative uses Embodied Learning in inquiry-based science education. It aims to enhance the participants' cognitive, physical, and emotional involvement, as well as their social interaction and communication between them. It leads students and participants to analyse and dramatize relevant information and concepts related to science. As a result, participants manage to constructively build on each other's ideas, enhance their learning of scientific concepts, develop and co-create potential solutions, coming up with strategies on how to communicate them and perform theatrical plays; overall fostering their transversal skills.

In the context of LSTT, students build their understanding on scientific concepts applying and developing knowledge from the whole curriculum (multidisciplinary approach) and become acquainted with the concept of learning science creatively. This way they manage to develop creative skills in a spirit of cooperation and teamwork in which various groups will create a 'cognitive object' such as script, scenography, costumes, music or even a video composition. This process engages students in a highly motivating environment where they learn to recognize, analyze and imagine alternative explanations and models and communicate a scientific argument or issue in a creative and alternative way. This enculturation in the scientific discourse can subsequently lead to epistemic improvement in pupils' knowledge. The argumentation process in this case might be the exchange of ideas and dialogue when the script of the theatrical performance is developed.

With a background of 9 years of implementation and a framework strongly aligned with the most recent EU demands for shaping the scientific literate citizens of the future, LSTT achieved a remarkable engagement of the target groups set and important results in the field of Science Education by involving, up to now, more than 5500 students, 550 teachers, 10000 parents and 1500 stakeholders.

UM and SV also bring in experiences from the STEAM Summer School. This was an Erasmus+ project originally created in 2016 as a 10-day intensive science communication course that brought together the resources of science communication academics and practitioners led by the University of Malta. The collaborators included Rhine-Waal University, Science View, University of Edinburgh, Haaga-Helia University and European Union of Science Journalists'

¹⁸ www.lstt.eu

Associations. Their approach was to cover diverse science communication and arts-related topics, focused on providing participants with the opportunity to engage public audiences during the course with science through artistic approaches that ranged from stand-up comedy to theatre.

The course was run as an experimental model supported by ERASMUS+ funding of the European Union. The funding allowed partners to test and evaluate variants of the course in Germany (2016), Greece (2017) and Malta (2018) to determine the courses' content, approach, pedagogic model and financial sustainability. In 2019 the course was successfully turned into a social enterprise and is now run yearly in Malta.

The school now takes a student-centred learning approach, entirely focused on project-based learning with theoretical content shifted to a flipped classroom approach. Over the 9-day course participants design, deliver and evaluate a STEAM event. At each stage, expert tutors provide the background knowledge needed and practical sessions to develop participants skills. These are immediately put into practice by applying it throughout the course by developing a STEAM event and delivering it in front of a public audience. Participants have created science stand-up comedy events, STEM online treasure hunts, promenade plays that fused culinary delights with historical performances and science, and other innovative formats.

4 The five elements of the participatory methodology

Within the context described above, the participatory methodology of Road-STEAMer has been developed to consist of the following five elements:

- Road-STEAMer co-creation workshops
- Road-STEAMer community events
- Road-STEAMer dialogues
- Road-STEAMer community development
- Technologies supporting participation and co-creation

These elements of the participatory methodology are presented in the following sections.

4.1 Road-STEAMer co-creation workshops

A central component of the participatory methodology are co-creation workshops. Several co-creation workshops will take place in Road-STEAMer with the participation of consortium

partners and members of the stakeholder community of the project. The purpose of these co-creation workshops is to help advance and enhance the work that the consortium will conduct under the core Work Packages (WPs) and specific Tasks within them, as foreseen by the description of the project. Thus, the co-creation workshops are integral parts of core work in Road-STEAMer, aiming to inform all aspects of the project with insights directly contributed by stakeholders. In this way the co-creation workshops materialize the overall participatory, bottom-up approach of the project which systematically seeks to generate better knowledge and shared understandings within the community of Road-STEAMer.

A co-creation workshop can be realized either in physical space or online (in the latter case, synchronously and/or asynchronously), as appropriate for the purpose and practical conditions at a given time and context. An online co-creation workshop can benefit greatly from combining the use of the chosen communication/conferencing channel with digital whiteboard collaboration tools (e.g. Mural, Miro).

Each of the co-creation workshops in Road-STEAMer will be designed and implemented so as to serve its purpose within the specific context of the project work to which it belongs. Thus, it will have a clear goal and agenda linked to specific objectives and work strands of the project. Co-creation in Road-STEAMer is defined as the practice of collaborating with stakeholders to guide the study and analysis process at hand. This is a central and essential element to each of the co-creation workshops. In this context, the following points will guide the organization of all co-creation workshops:

- Co-creation workshops should be facilitated so that participants with different roles will align and offer diverse insights enabling more holistic views of the ecosystem of factors and actors operating at different levels and in different ways in relation to the object of analysis or study.
- Co-creation goes deeper than merely asking stakeholders, being predominately about developing and making the best of a shared culture. Design thinking, cross-pollination of expertise and viewpoints, empathizing with the co-participants to find the right problems to define and address, and a highly interactive agile approach allowing participants to collaborate progressively are essential elements.

Advice for successful facilitation of a co-creation workshop so as to get the most from a productive collaboration with stakeholders may be summarized in the following points:

- Base the workshop on a clear overview of what you want to examine and define specific goals. Work backwards to make a concrete plan, by determining what you want to achieve and then designing the steps towards it. Prepare a detailed agenda. List tangible wished outcomes to tightly manage the co-creation workshop and avoid unrealistic pursuits.

Decide about the appropriate mode (physical or online), place and/or digital means, time and duration.

- Decide who needs to be there and only include relevant participants. Make sure you invite stakeholders from across the board, provided they can contribute. Include domain experts. Get everyone on board by embracing their strengths and pooling their knowledge. Tap the sheer variety of viewpoints, information, solutions and levels of ownership that each one of the co-creating participants possesses.
- Ensure the workshop is interactive and build on design thinking methods. Start within introductory warm-up activities. Consider brainwriting rather than brainstorming, and make use of the power of visual and spatial methods and tools to sketch out and map ideas. Stay curious and keep listening. Keep track of the time, but also allow enough time for collaboration to evolve.

To monitor the achievement of the stakeholder engagement goals of the project, the Road-STEAMer co-creation workshops realized will be documented in terms of the number of participants categorized by stakeholder typology and demographics, as well as their expectations and satisfaction with the event. In addition, the final output of each co-creation workshop will be a report for internal project use providing the resulting input to the project processes involved, e.g. in the form of information or data gathered and conclusions drawn. The results of the co-creation workshop are to be shared not only within the core team organizing it, but also with the rest of the consortium, the stakeholder community, and predominantly with the participants of the workshop.

Planning the co-creation workshops will evolve continually in line with the evolution of the work and the arising conditions and circumstances. It is possible to combine more than one co-creation workshop in one event, if they coincide on the timeline of the project and share common thematic ground and needs for interaction with specific stakeholders.

At the time of preparing the present participatory methodology, the consortium has already made some plans for the realization of co-creation workshops, as presented in Table 3.

Table 3: Initial plans for the realization of co-creation workshops

| Linked to WP/Task | Initiator/organizer | Time (project month) | Purpose | Where/How |
|------------------------------------|----------------------------|-----------------------------|---|--|
| Task 1.1 Participatory methodology | EA | M2 | Co-develop the participatory methodology of the project | Online meeting and online shared document (consortium) |
| Task 2.1 Socio- | ZSI | M5 | Towards an agreed analysis of the socio- | Co-organised online |

| | | | | |
|--|-----|--------|---|---|
| economic context and need for STEAM | | | economic context and need for STEAM in Europe's science education | (consortium and possibly selected stakeholders) |
| Task 4.1 Research framework | UoE | M5 | Towards defining criteria for the identification of practices | |
| Task 2.2 STEAM conceptual framework | UoE | M10 | Towards an agreed STEAM conceptual framework | Online with supplementary face to face session if coincides with project meeting and/or ECSITE conference (in latter case, co-organised with UM) (consortium and selected stakeholders) |
| Task 2.3 Conditions and requirements for effective STEAM | EA | M17 | Towards an agreed analysis of the important conditions and requirements for the effective integration of STEAM in science education in Europe | To be decided |
| Task 4.3 Real-life use-cases | EC | M6-20 | 3-6 participatory action research workshops complementing the desk research in various formats (design thinking, participant observation, focus groups, hackathons) | To be decided (2-3 workshops concentrated in time, involving many at the same time; and 2-3 with a longer timespan involving less people at each moment) |
| WP5 | PO | M18-19 | Kick-off of the task to co-create a synthesis and define the methodology to meaningfully aggregate the | To be decided (probably in Milan, Italy) |

| | | | | |
|-----|-----------|--------|--|--|
| | | | projects' learning for the roadmap | |
| WP5 | PO and LC | M22-23 | Series of (online/offline) workshops to co-design the roadmap with an iterative approach | To be decided (including probably in Milan, Italy) |

4.2 Road-STEAMer community events

Next to the focused co-creation workshops described above, another central element of the participatory methodology is the organization of several public events within the community of Road-STEAMer, with a wider agenda and approach.

The aim of the Road-STEAMer community events is to bring together project actors into rich instances of exchange, dialogue and mutual learning, always linked to the project processes of analysis or study (WPs 2-5), but with a wider participation and a less tightly-defined process in comparison to the co-creation workshops.

The consortium sets the goal to organize at least 30 project community events.

Of those, 7 major project community events will take place in different locations in Europe, hosted by different partners, and in conjunction with the project meetings as well as local initiatives organized by the hosting partners, thus economizing on organizational and travel expenses. In principle, for each decision for a physical consortium meeting should be combined with a decision for a major project community event that will be organized in conjunction with that meeting.

Further, consortium members will organize several local events tailored to the needs of the project for interaction with the stakeholder community in the local/regional/national context. Overall, the consortium sets the goal to organized at least 23 local events, generally distributing them widely in the different participating countries (e.g. approximately 2-3 per country). The initiative for the organization of a local event will typically come from the respective local partner.

In all project community events physical and digital spaces will be exploited as appropriate.

The thematic focus, the approach, and the format of the Road-STEAMer project community events may vary widely to match specific purposes and conditions at a given time of the project life cycle and in a specific context. However, every project community event will:

- Involve members of the stakeholder community of the project, rather than merely addressing the general public (with the latter falling within the remit of WP6 'Dissemination and Exploitation').
- Be clearly linked to certain aspects of the work of the project, enhancing or promoting them through the interaction with the stakeholder community. This will be clearly reflected in the goal, agenda and setup of the project community event.
- Produce and provide useful input to the project processes involved, e.g. in the form of information or data gathered or a report of results, as agreed with the consortium partners responsible for the project work to which the event is linked.

So as to monitor the achievement of the stakeholder engagement goals of the project, the Road-STEAMer community events realized will be documented in terms of, at least, the number of participants categorized by stakeholder typology and demographics, as well as their expectations and satisfaction with the event.

4.3 Road-STEAMer dialogues

Throughout the project the consortium will develop and operate the Road-STEAMer dialogues, a scheme of coordinated, structured dialogue on the interactions of STEAM with various aspects of science education of current interest. Such aspects may include curriculum-related questions, science-related competences and careers, Responsible Research and Innovation, gender and inclusion, open science, open schooling, synergies of formal, non-formal and informal science learning spaces, the need for change in schools and school systems, etc.

The thematic content of Road-STEAMer dialogues will be defined by the consortium in the course of the project, based on the results available at a given time as well as the need for in-depth, focused stakeholder input at that time in the life cycle of the project (e.g. towards a specific deliverable). For example, as an early plan already discussed at the time of preparing the present participatory methodology, it would be useful to link the dialogues process with the development of initial recommendations for the STEAM roadmap as well as with a dialogue with policymakers and industries related to STEM to feed the roadmap with industry needs and policies constraints (cf. WP5).

The Road-STEAMer dialogues will take place in physical and/or digital (synchronous and/or asynchronous) spaces, as appropriate for the purpose and each context. It may be useful for digital editions of the dialogues to make use of the social media of the project. As a priority, dialogues in physical space will be organized in conjunction with 7 major project community events that will take place in different locations in Europe, as described in the previous section.

The dialogues will involve all consortium partners and stakeholders from the Road-STEAMer community as well as any other interested parties who will be approached and invited to participate through the communication and dissemination efforts of the project.

The overall process will involve three cycles, one per project year. Each cycle will commence with a relevant review of a certain area of the STEAM landscape (e.g. of literature and/or good practice), ideally linked to relevant project work and outputs that will be active or due at that particular time.

On this basis, the circulation of short, thought-provoking position papers seeking to inspire and motivate participants to contribute to the dialogues will follow.

Exchange of views and arguments will be moderated for a specified short period, and the results will be summarized in concluding dialogue digests in the form of points of consensus and points of contention, and a list of challenges and opportunities lying ahead.

The position papers and digests resulting from the dialogue process will be widely disseminated through the communication and dissemination channels of the project.

Finally, the consortium will actively explore ways and develop initiatives to combine the above process with the communication and dialogue that Road-STEAMer seeks to maintain with its sister projects as well as with the European Commission (EC) and the Organisation for Economic Co-operation and Development (OECD). It is particularly fit for this purpose to develop a synergy between the process of Road-STEAMer dialogues and the three policy briefs that the project will produce at the end of each project year in order to convey project results to policy makers in easily understandable and approachable ways and thus boost the agenda of STEAM in Europe (deliverables D7.4, D7.5, and D7.6).

4.4 Road-STEAMER community development

Road-STEAMer will systematically engage members of all stakeholder communities from different parts of Europe, drawing on all consortium partners' extensive networks and numerous previous and running projects with strong stakeholder engagement elements.

The project will particularly utilize its close links to the OSOS and SALL projects (through EA, coordinator of these two open schooling projects which have developed networks of more than 1,000 and more than 400 school communities from across Europe respectively), in order to be in direct interaction with a multitude of school communities and real-life science education realities on the field.

Overall, at least 1,500 individual members of the Road-STEAMer community will be involved in the project processes, coming from at least 10 countries, i.e. the 8 countries of the consortium partners (Austria, Belgium, France, Greece, Italy, Malta, Netherlands, UK) plus the two additional countries accessed through the third parties of EC.

An analysis of the minimum numbers of individuals from the various stakeholder communities that will be closely engaged in Road-STEAMer, based on the promise made in the description of the project, is presented in Table 4. Note that in section 1.2 'Key actors in Road-STEAMer' the present document is providing a finer definition of the stakeholder communities.

Table 4: Initial plans for the realization of co-creation workshops

| Stakeholder communities | Minimum number of individuals engaged in Road-STEAMer |
|---|--|
| School education teachers/experts | 50 |
| Higher education teachers/experts | 50 |
| Informal/non-formal science educators | 50 |
| School education students | 550 |
| Higher education students | 250 |
| Informal/non-formal science education learners/audience | 250 |
| Research and innovation community members | 50 |
| Creative community members | 50 |
| World of entrepreneurship and business members | 50 |
| Policy makers at various levels (local to European) | 50 |
| Citizens, third sector organization members | 100 |
| Total: | 1,500 |

EA will be the central node of the work that will form, manage and sustain the Road-STEAMer community, through information campaigns, invitations for collaboration, various incentives for active engagement (including playful engagement design, contests with various prizes including educators' and/or students' participation in European events), as well as continuous information and support.

In this, EA will collaborate closely with the consortium members who will act as the National Coordinators (NC) of activities in their respective countries managing them in accordance with the local circumstances, possibilities and requirements.

The community is being intensively set up in the very early stages of the project, aiming at achieving full stakeholder involvement in all aspects of the work.

Current emphasis is put on developing arguments that speak to stakeholders' intrinsic motivation (Why should they participate? What's in for them?). The aim is to maximise the "what's in there for me" effect for external participants, ensuring they have a clear stake and a guaranteed reward (e.g. reflexivity, knowledge, network, etc.) in the work to be done collectively. Relevant invitation texts are being prepared and all consortium members are actively exploring ways to draw in their existing collaborations and networks most effectively for the purposes of Road-STEAMer.

Further details on the development and management of the Road-STEAMer community will be provided in deliverable D1.2 'The Road-STEAMER community' in M6.

5 Technologies supporting participation and co-creation

Road-STEAMer is leveraging state-of-the-art technology to support and enhance the processes of community development, exchange, dialogue, and stakeholder engagement. Building on rich expertise contributed by ENG, Road-STEAMer is building its tailor-made Community of Practice (CoP) ICT suite as an easy-to-use web-based set of tools, utilizing existing open source solutions and linked with existing solutions for virtual meetings and collaborative dashboards, as well as tools for the visualisation of information drawn from open datasets.

The development of this technological support is in progress. Available technological solutions and components to be taken into account have been investigated, and the identified ones will be tailored for the purposes of the project. The first version of the suite will become available in M6 so as to support the early stages of the work. Subsequently, it will be continually improved throughout the project and finally delivered as deliverable D1.4 'Road-STEAMer CoP suite' in M36.

5.1 Requirements for Community of Practice functionalities and tools supporting participatory and co-creation processes

The consortium has defined requirements for the functionalities and tools that can support the participatory and co-creation processes of Road-STEAMer. It has been defined that the online tools should be low-key and easily accessible (free of cost, easy to operate, usable on different devices), and allow for co-creation, e.g. through interactive and multi-author elements. Clear instructions introducing the new tools will be needed. Depending on resources, it would also be useful to develop a digital mock-up to test user-friendliness and usefulness for different stakeholders.

On this background, this section provides a preliminary analysis of possible tools, functionalities, and technical capabilities investigated to support the co-creation processes.

During the project execution, a sub-set of the explored and selected tools and functionalities will constitute the RoadSTEAMer Community of Practice Suite (RCS), in order to provide a coherent environment to support co-creation and participatory activities.

The RCS will be designed as a web-based collaborative tools system, and built on existing open-source solutions, to simplify its adoption and potential replicability. Specifically, RCS will offer functionalities to generate participatory processes (e.g. debates, civic initiatives etc.) or surveys as well as to vote on concepts, ideas or solutions. Moreover, it will also offer different interactive services such as feedback collection, blog, and forum threads, thus enabling partners' participation and collaboration while performing different tasks.

Tables 5 and 6 provide a non-exhaustive list of possible functionalities and tools for building RCS.

Table 5: Preliminarily identified base functionalities of the RoadSTEAMer Community of Practice Suite

| Functionality | Description |
|--|--|
| User registration | Enables the registration form and allows any user to create a new account and login. |
| Content creation | Allows users to create proposals, ideas, needs and solutions (with text, images, etc.). |
| Content exploration | Allow users to navigate, filter and interact with published contents. |
| Content voting (evaluation and selection): | Offers users the possibility of voting on published contents (e.g. on ideas, proposals). |

| | |
|--------------------|---|
| Comment comments | Allows the users to comment on published contents. |
| Survey management | Allows users to participate in surveys, submitting their opinion. |
| Multilanguage | Allows the users to access the functionalities in different languages. |
| Data visualisation | Allows the users to visualise information using charts, graphs, etc. to make data easier to understand. |

Table 6: Preliminarily identified tools for the RoadSTEAMer Community of Practice Suite

| Tool | Description |
|-------------|---|
| DECIDIM | Decidim is a framework offering functionalities enabling democratic participation on the Web. |
| IDRA | Idra is a web application able to federate existing Open Data Management Systems (ODMS) based on different technologies providing a unique access point to search and discover open datasets coming from heterogeneous sources. |
| DASHRAM | Dashram is a tool for data visualization, characterized by a simple and functional interface that provides the means to create and share 2D and 3D charts, map-based visualizations and dashboards. |
| MIRO | Miro is an online whiteboard tool built to help users collaborate with others. Miro provides features with multiple options for real-time collaboration and asynchronous teamwork on an online whiteboard. |
| MURAL | Mural is a digital tool for visual collaboration. It is a digital whiteboard collaboration space, where teams work together in real-time or asynchronously. |
| CLICKUP | ClickUp is a web tools that allows team collaboration and organisation. It helps team on assigning tasks, creating and editing documents as well as functionalities like boards, calendar Ganttts and so on. |

6 Conclusion

While the above described participatory methodology refers to the development of dialogue and mutual learning within the community of the Road-STEAMer project (consortium members and stakeholders engaged in the project processes), the very nature of dialogue and mutual learning makes the participatory methodology synergistic and complementary to the efforts of the project for communication, dissemination and exploitation addressing the world beyond the boundaries of the immediate project community.

This ‘outward’ function of the project is performed in the context of WP6 ‘Dissemination and Exploitation’. The development of the Road-STEAMer community and of dialogue and mutual learning within it will naturally be facilitated through this work, which aims to provide an integrated, solid external image of the project in order to facilitate its recognition, raise

awareness about it and attract the relevant target groups. In this context Road-STEAMer will target relevant stakeholders and policy makers at various levels with tailored communication, dissemination and exploitation actions. Predominantly, in this the project community will find means and tools to expand by approaching and engaging new members, and to engage with the public in further dialogue and exchange.

Further, the conception of Road-STEAMer includes the notion of National Coordinators (NC), i.e. consortium members in charge of implementing the project activities and especially stakeholder reengagement in their national contexts. Among their other duties, the NCs will make sure that the participatory methodology described in this document will be implemented in their countries in ways appropriate for each local and organizational context. To cater for this great variety of settings in which project activities are expected to evolve, instead of a recipe, in the participatory methodology the community of Road-STEAMer should see a consistent but flexible overall framework which invites to its adaptation and application in the diverse contexts in which the project is being implemented.

Finally, the participatory methodology of Road-STEAMer is being presented in the current document at the very early stages of the project, as an overall framework to guide all project activities towards integrating participation, dialogue and mutual learning. Naturally, the present methodology is a starting point rather than an end. The framework presented in this document will evolve in the course of the project, together with the participatory activities that it will trigger. In this sense, it should be regarded as an open tool which will be continually enriched in the light of the insights that its users will gain through its application for the organization of participatory activities on the field.

Annex: CREATIONs Workshop Guidance documentation



CREATIONS: Workshop Guidance

These activities draw on the idea of the workshop creating a living dialogic space via creative learning conversations in which all participants are listened to and have a voice.¹ This approach has been used in order to model the kind of facilitation and pedagogy that the CREATIONS project itself is aiming to encourage. Each workshop should contain 15 – 20 people from across the target groups. A digital recording sheet has been provided; please input data directly into this sheet, including photos where possible.

Information gathered in the workshop will be used to inform the writing of a CREATIONS report; participants can have access to the information gathered if they so wish. Please make sure you tell the participants this at the beginning of the session, and ensure you take contact details where appropriate.

Aim: to get people thinking and talking about:

- o what creativity in science education is for them
- o what initiatives they are aware of that they think achieve this and engage students via different means including the arts and culture
- o what pedagogies they think are key to this

1 Warm up (20 mins)

- 1 Please sit down at your table (suggestion is 4 – 5 people around a table) organising yourselves in alphabetical order around the table according to your first name
- 2 Once you're sat down please introduce yourself and say ONE sentence each about your role in relation to science education
- 3 Temperature taking - see the middle of the table as very hot/positive and the edge of the table as very cold/negative. Place your hand on the table in terms of how positive/negative you currently feel about the state of creativity in science education. Briefly share your reasons for where your hand is.

Facilitation: keep people to one sentence for the first part of this task otherwise it will take too long. Keep discussion for 3 focused on why they put their hand where they did – this does not need to be done individually but can be done in clusters – taking examples of reasons from those who are near the centre/further away from the centre.

Documentation: The facilitator should take a photograph of where the hands are placed and note key examples digitally on the documentation sheet.

2 What is creativity in science education? (20 mins)

In groups of 4 – 5 workshop participants rank or arrange key elements that make up the definition of creativity in science education. Remember the definition will be used across Europe, across primary and secondary education so

¹ Chappell, K., & Craft, A. (2011) Creative learning conversations: producing living dialogic spaces. *Educational Research*. 53(3) pp. 363–385.



it needs to be abstract enough to encompass multiple forms of practice. The current suggestion from the end of the CREAT-IT project is:

“Purposive and imaginative activity generating outcomes that are original and valuable in relation to the learner. This occurs via generating ideas and strategies as an individual or community, reasoning critically between these and producing plausible explanations and strategies consistent with the available evidence”.

Elements separated out on slips of paper are:

Purposive and imaginative activity

Outcomes that are original and valuable in relation to the learner

Generating ideas and strategies

Individual and community

Reasoning critically between ideas

Producing plausible explanations and strategies consistent with the available evidence

Conclusion of activity - How close does each group feel the creativity in science education definition is for them?
What amendments, if any, would they make?

Facilitation: this needs an envelope with the words below written on slips of paper, as well as some spare slips – the aim is to allow everyone in the group a voice – techniques to help this include asking each person to read out an element of the definition, and working round the group asking people to contribute briefly in turn rather than having an open floor speaking policy, where more dominant voices may take over. Re ranking or arranging, participants may want to place the elements in a top down list, spanning out from a central point where centre is most important – this is open to interpretation by the group.

Documentation: The facilitator should take notes, digitally on the documentation sheet, regarding major amendments to the definition being offered. They may also wish to note any major differences of opinion. And also take a photograph of the final arrangement of the elements of the definition.

3 Initiatives in creative science education (20 minutes)

Working digitally in pairs or threes, participants share examples of good practice re creativity and engagement in science education under the following headings:

IBSE or inquiry-based

Arts or culture-based

Others?

For each initiative, need to clearly obtain:

Name

Web address

Any particular science focus



Other disciplinary/cultural/digital elements

Bearing in mind the definition above – why do they think the initiative is:

1. Creative
2. Leads to better engagement in science education

Facilitation: encourage participants to talk and record their discussions in pairs for 10 minutes either on their own laptops/tablets or on paper and then take a photograph, and to highlight one initiative from their discussion which they think is most creative and engaging in terms of science education. For the last 10 minutes of this task the pairs share their chosen initiative with the group. Be clear that the information shared in this section can be made available to participants soon after the workshop.

Documentation: The facilitator should make sure whatever digital tool is being used that all elements are recorded for each pair where necessary to save them having to chase up key details later.

4 Pedagogies in creative science education (25 mins)

Participants work in 5s. Working with the metaphor of the creative process in science education as a journey, ask each 5 to draw a large vehicle of their choice on a piece of flipchart paper (bus, bicycle, aeroplane etc). Then ask them to use the 8 provided post-it notes to annotate the image with the key pedagogies for the creative process in science education. Provide spare post-it notes for them to add their own pedagogies too drawing on their own practice or theoretical knowledge. The CREAT-IT principles will need explaining before they begin. Use the first 15 minutes to explain the pedagogies and have them develop their image/post-its. Use the last 10 minutes for the groups to briefly share their positioning of the CREAT-IT pedagogies, their new pedagogies, journey end and break downs.

Facilitation: You will first need to explain the 8 CREAT-IT pedagogic principles (details attached). For the annotation exercise, prompt questions might include – Which pedagogies are the engine of creativity in science education? What pedagogies do you need in your boot to bring out when appropriate? Who are the key people in the vehicle that you're using the pedagogies with? Is there anything else that you might want to have on the journey e.g. on the roof rack? What might cause you to break down on your journey (encourage them to draw this as well as write)? Dependent on your group and cultural context, you may wish to develop your own metaphor for this exercise which encourages people to discuss and document the 3 key elements re their opinion of the principles, any new pedagogies and any issues that they raise.

Documentation: The facilitator should make digital notes either during or after the workshop picking up on key discussion points including:

- o whether all groups are able to place all 8 CREAT-IT principles*
- o what new pedagogies each group adds (including key references where appropriate)*
- o and what breakdown causes are.*

Please also take a picture of each piece of flipchart paper.

5 Wrap up (5 mins)

This workshop process has been designed by the University of Exeter CREATIONS team. For further information please contact Kerry Chappell or Hermione Ruck Keene: k.a.chappell@exeter.ac.uk or H.RuckKeene@exeter.ac.uk



Thank all participants for their contributions. In a circle, or arrangement where everyone can see each others faces ask all the participants to offer one word summing up how they have felt about the workshop, and one sentence saying what they will take away from it.



Documentation sheet: Please remember to record for all groups in relation to each activity – please save this sheet as a separate document for each workshop that you carry out. Boxes will expand as you type into them.

| | | |
|------------------------------------|---|-------------------------------|
| Workshop facilitator: | Workshop date, time and venue: Number of participants: (Please also complete the separate sheet detailing participants names and categorisation) | |
| ACTIVITY ONE: WARM UP | Record reasons for the placement of hands | |
| ACTIVITY TWO: DEFINITIONS | Amendments to the definition | Differences of opinion |
| ACTIVITY THREE: INITIATIVES | Workshop participants should record their ideas digitally – either on their own laptops/tablets or on paper and then take a photograph. Please transfer their ideas to this column or include them as a separate document. | |



| | |
|-----------------------------------|--|
| ACTIVITY FOUR: PEDGAGOGIES | Key discussion points <ul style="list-style-type: none"><i>o whether all groups are able to place all 8 CREAT-IT principles</i><i>o what new pedagogies each group adds (including key references where appropriate)</i><i>o and what breakdown causes are.</i> |
| | |



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Resources:

Flipchart paper

Post-its

Coloured pens

Ranking statements – to be printed and cut out x 4 for use by up to 4 groups

Purposive and imaginative activity

Outcomes that are original and valuable in relation to the learner

Generating ideas and strategies

Individual and community

Reasoning critically between ideas

Producing plausible explanations and strategies consistent with the available evidence

CREAT-IT principles – see following page



CREAT-IT Pedagogical Principles

Professional wisdom is respected and encouraged across the principles: it is vital that the approach recognises practitioners' wealth of teaching and discipline knowledge and expertise. This is a deeply contextualized knowledge often informed by intuition, which needs to be in constant conversation with science ideas and theories. The connected principles are as follows:

1. **Individual, collaborative and communal activities for change:** practice can allow for all three ways of engaging in activities, and particularly in relation to communal engagement can take advantage of the shared identities within which participants will work, allowing for difference but with a shared creative process and purpose.
2. **Risk, immersion and play:** allowing for these three processes to filter across learning and recognize how pedagogy can assist in creating literal space as well as 'thinking' space for these to occur.
3. **Dialogue:** practice can allow for dialogues between people, disciplines, creativity and identity, and ideas. This dialogue needs to acknowledge embodiment (i.e. dialogue is not simply a verbal activity) and difference and allow for conflict and irreconcilable difference. It is important to facilitate open discussion of the questions generated by pupils (bottom up) and bring these into dialogue with live questions from professional science and science education (top down).
4. **Interrelationship of different ways of thinking and knowing:** the pedagogy allows space for different ways of thinking (e.g. problem-finding, problem-solving, exploring, rationalizing, reasoning, reflecting, questioning, experimenting) focused around shared arts/science threads or throughlines. At the arts/science interface it can also offer the space for three different ways of knowing (knowing that - propositional knowledge, knowing how - practical knowledge, knowing this - aesthetic or felt knowledge), as well as acknowledging the embodied alongside the verbal.
5. **Discipline knowledge:** understanding the importance of allowing space for the rigorous discipline knowledge of both the sciences and the arts is vital, as well as understanding the importance of materials relevant to those disciplines (e.g. their bodies, with props, with paper and pencil, with sculpting materials, with Bunsen burners and test tubes, with chemicals, with equations) and how creativity might interact with these disciplinary knowledge bases differently, albeit in the context of science education.
6. **Possibilities:** – practice can allow for multiple possibilities both in terms of thinking and spaces, and know when it is appropriate to narrow or broaden these
7. **Ethics and trusteeship:** adult professionals and learners consider the ethics of their creative science processes and products and be guided in their decision-making by what matters to them as a community, acting as 'trustees' of that decision-making and its outcomes.
8. **Empowerment and agency:** through empowering pedagogies, CREAT-IT can allow both learners and adult professionals to gain a greater sense of their own agency and ability to express themselves, and to then know what to do with that in order to be more creative scientists and to develop more creative science teaching techniques. Enabling pupil agency and encouraging children to try out (and critique) their own ideas in investigations were also key factors to emerge from the survey, thus emphasizing the importance of this principle.