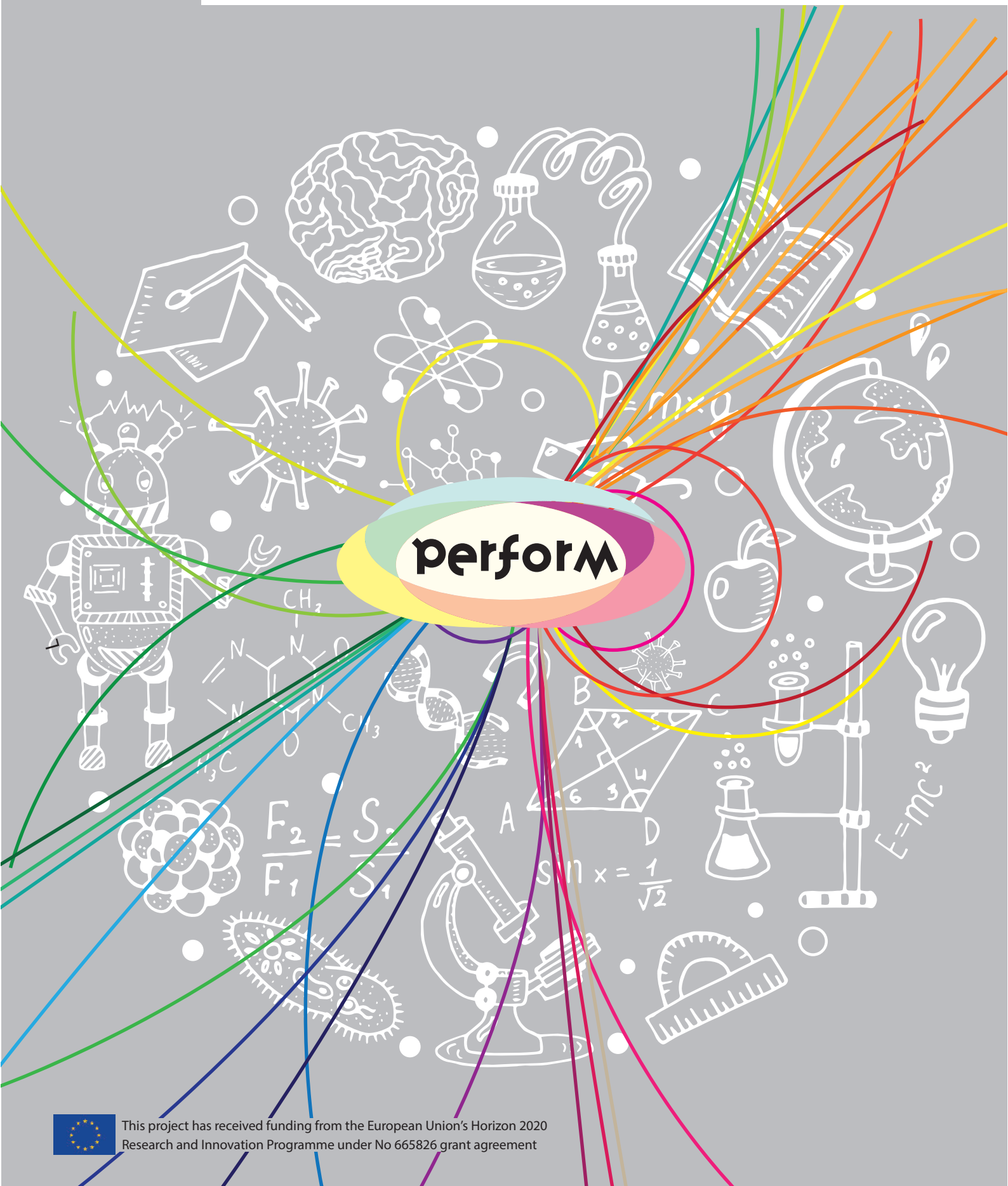
Policy Brief

Participatory Engagement with Scientific and Technological Research through Performance

#2

Policy recommendations on the role of teachers in motivational educational processes in STEM: the findings of the PERFORM project



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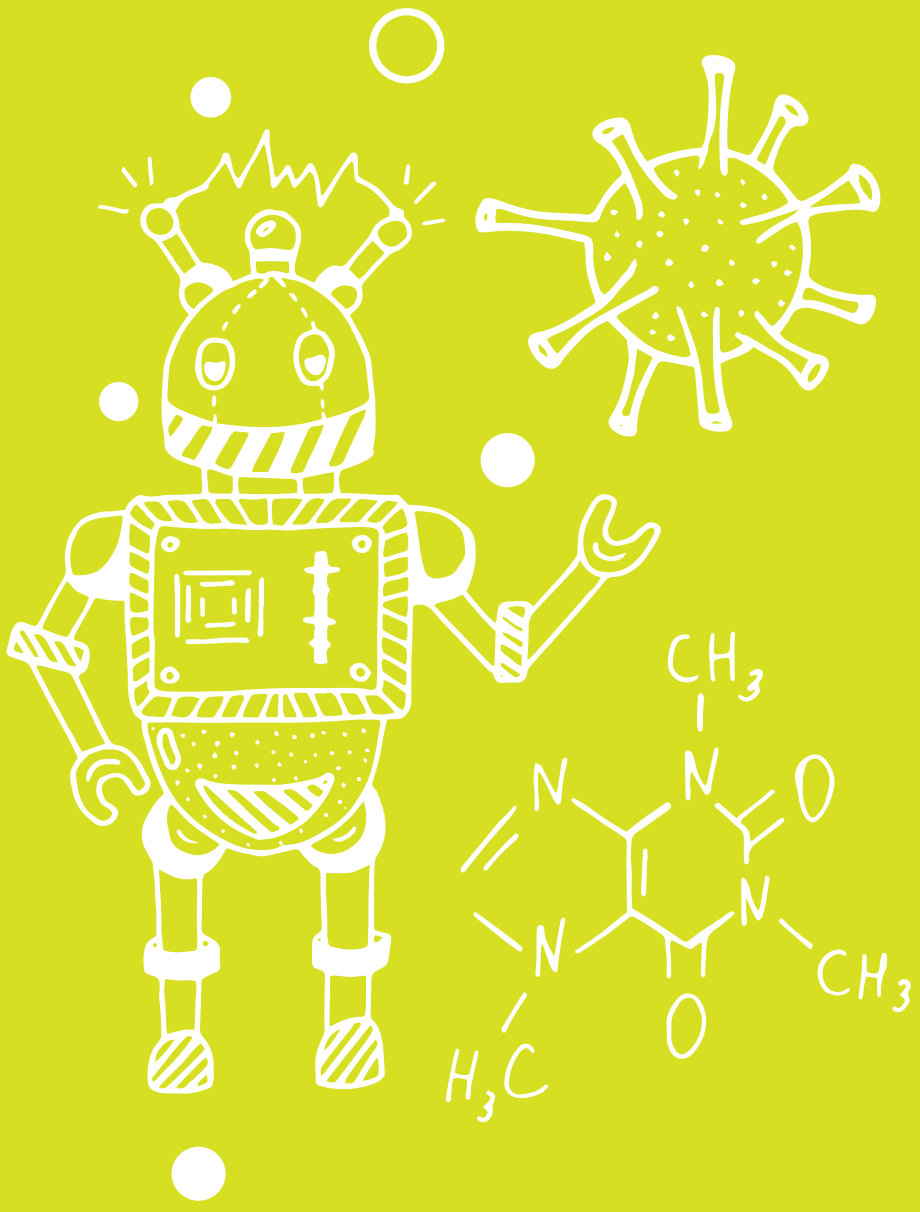
Ch. #1 Introduction



> Summary

PERFORM is a European Commission-funded Horizon 2020 project centred on the development of innovative science communication tools in the performing arts, with the aim of inspiring and motivating young people to pursue Science, Technology, Engineering, and Mathematics (STEM) academically and professionally, while encouraging young people to develop a more reflective and holistic understanding of science.

PERFORM posits that there are opportunities to innovate in science education, moving away from traditional models where the transfer of information is unidirectional and vertical from above, from teacher to student. PERFORM creates participatory and inclusive learning processes, with an emphasis on engaging and inspiring young people.

In its three pilot countries, France, Spain and the UK, the project explored the use of the performing arts to directly involve young people in honest and transparent learning processes, to emphasise the human elements of science and research, and to help young people develop transferrable and critical skills.

Teachers play an important role in the framework of the PERFORM project. Alongside early career researchers (ECRs), science communicators and young people, secondary school teachers took part in performance-based science education workshops which were held over two rounds in France, Spain and the UK. The role of the teachers is primarily to facilitate and support the performance-based activities; they help to stimulate discussion on the relationship between science and society in the classroom, and promote an understanding of Responsible Research and Innovation (RRI) values. They contribute to workshops alongside students, and help to foster an inclusive learning environment involving all students in the processes. Teachers also help to adapt workshop activities to their specific schools.

Prior to the workshops, some teachers took part in bespoke training sessions, helping them to develop the skills necessary to facilitate the sessions. After the workshops, teachers are encouraged to incorporate performance-based techniques and tools for provoking discussion in the classroom, and to continue to raise wider questions about science and its role in society in the context of the RRI framework.

Responsible Research and Innovation values are deeply embedded into the project. The European framework for RRI seeks to align research and innovation with broader social values, emphasising the importance of public engagement, gender equality, science education, ethics and transparency in research, and responsible political governance of research and innovation.

As part of the **PERFORM process**, students from twelve selected secondary schools from low and medium socio-economic backgrounds in Barcelona (Spain), Bristol (UK), and Paris (France) took part in performance-based science education workshops with early career researchers and teachers. The performance activities were designed and tailored for each country:

1. Science monologues **(Spain)** 2. Improvisation and clowning **(France)** 3. Science busking **(UK)**

This policy brief will offer, and make the case for the need for, policies to include secondary school teachers in educational processes to motivate, inspire, and encourage reflection from young people, based on the findings and values of the PERFORM project.

Ch. #2 The Role of Teachers in PERFORM

The involvement of teachers in performance-based science education workshops

PERFORM designed and conducted a process in which secondary students, alongside teachers and early career researchers, developed their own science performances in a series of workshops. The workshops took place over two rounds, involving a total of 253 students, 30 teachers and 44 early-career researchers. Based on learnings from the first round, workshops were improved for the second, fine-tuning the sessions to local particularities, and emphasising certain RRI aspects.

Prior to the workshops, teachers collaborated with science communicators to help adapt science education activities to their particular schools. During workshops, teachers helped facilitate the direct interaction between young people, ECRs and science communicators. They also actively participated in the process and fostered an inclusive atmosphere during workshops.

Supporting young people's engagement in STEM

By having a place within the PERFORM framework, teachers are able to:

1. Foster young people's scientific learning by facilitating their involvement and participation in performance-based science education activities.

2. Help challenge young people's stereotypes about scientists by helping to foster direct relationships between early career researchers (ECRs) and young people. ECRs, in turn, can show that people of all genders, ages and ethnicities are and can be scientists.

3. Bring Responsible Research and Innovation values into young people's frameworks, raising wider questions relating to science and society.

A toolkit to train teachers

The University of Bristol, the Big Van Theory and TRACES carried out bespoke training courses for teachers in 2017 and 2018. The training focused on tools for generating productive and engaging classroom dialogue, and on performance techniques. Focusing on dialogue, teachers were encouraged to come up with questions about science that would arouse philosophical dialogue on ethics and politics. Examples of performance-based activities were offered and practiced with teachers to help engagement.

From the experience of training teachers, the University of Bristol developed a teacher-training toolkit, which is available to be used in teacher-training courses, or by teachers independently.

The aims of the toolkit are to:

1. Provide teachers with resources and tools to provoke discussion on science and society in the classroom.

2. Support teachers in conveying transferrable competences and skills to students through performance activities and classroom discussions. These include critical and analytical skills, personal skills such as the ability to manage time and learn effectively, and social and civic competences.

The toolkit contains resources for teachers to use in lessons, such as:

1. **Performing science activity cards**: each card presents a piece of art which illustrates an ethical question relating to science and society. Following this, a short performance-based activity is suggested, along with an outline on how to facilitate it within the classroom.
2. **'Meet the scientist' videos:** these introduce the different early-career researchers working within the PERFORM framework, who present themselves on a personal level. The ECRs explain the importance of scientific research and its implications in society. The videos can then be used to provoke discussions and wider questions about science.

The toolkit offers educational and communication approaches for exploring public engagement, emphasising narrative and storytelling as a means of bringing science to life.

Teachers' and educators' responses to the training indicated that they perceived that techniques from drama would engage students, inspire their curiosity and interest, encourage them to direct their own learning, to remember content of lessons and to link what they were learning about to wider, social worlds that were personally meaningful.

Teachers suggested that there were some constraints on implementing PERFORM techniques, such as the dynamics of pupils' behaviour in the classroom, the confidence of students to perform, the confidence of teachers to use the techniques, and deadlines in completing school curricula.

I learned...

"**Creative, non-linear ways of creating non-fiction content**: new ways of storytelling, more interesting hooks that appeal to children who might not otherwise be interested." – Teacher, Bristol

"The **importance of storytelling** in creating memorable experiences" – Teacher, Bristol

"[It was] great to reflect on how we create space and thinking time for students to think scientifically and **not just view science as facts**. It's the most powerful tool for combatting 'post truth' and [for conveying] the **most valuable transferrable skills** [to] students [...]" – Teacher, Bristol

Ch. #3 Evidence and Analysis

> Overview

PERFORM tested how young people reacted to its workshops both quantitatively, through students' inputs in surveys, as well as qualitatively, from observations conducted in workshops and qualitative interviews. A questionnaire was given to the students before and after workshops, and additionally to a control group who did not attend workshops.

Data were collected from 12 schools from low and medium socio-economic backgrounds in the UK, Spain and France over two rounds of workshops. At the time of writing, aggregated data from all the workshops was not available for every indicator. We therefore show data from a variety of experiences. In some cases, we focus on the results from our first round of workshops in Terrassa, Spain, which we compare to our experiences from the same round in Vauréal, France, and Bristol, UK. These results may not always be representative of all of our experiences in the Spain, France and the UK, but they do reflect general patterns which show the potential of our approach.

The data shown from Terrassa represent the 33 students in the PERFORM group who answered a questionnaire before and after workshops. The control group in Terrassa was made up of 16 students. The data from the workshops in Vauréal and Bristol represent the answers of 19 students in each group.

It was found that most young people were satisfied with their interactions with teachers in the workshops. Young people showed increased levels of engagement and interest with science and science-related issues, and there was an improvement in young people's understanding of the role of science and RRI values.

For each statement shown in italics, students expressed how much they agreed or disagreed with it, shown here on a scale of 1-4.

Interactions with teachers

1. 'I feel my work during workshops was recognised by teachers'

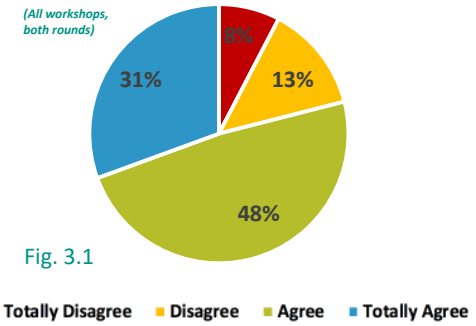


Fig. 3.1

One way of measuring the success of the interactions between teachers and young people is to analyse the extent to which young people felt satisfied with these interactions. Part of the role of teachers in the workshops was to observe the work and contributions of young people. 79% of the students across all the workshops felt that their work had been recognised by their teachers, and only 21% felt that their work had not been recognised.

Understanding science and RRI values: the utility, methods and ethics of science

2. 'Science will help me understand more about global issues'

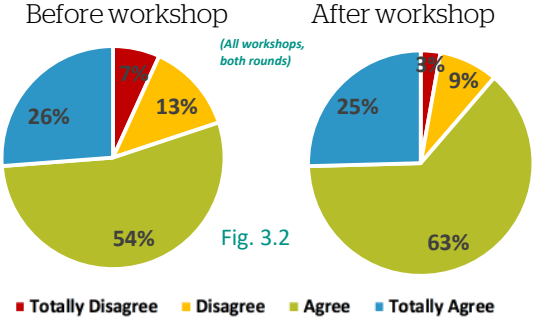


Fig. 3.2

In Fig. 3.2, we see that across all the workshops, there was an 8% increase in agreement with the view that science helps to understand global issues. This suggests that young people increasingly saw science as being epistemically and socially useful after the workshops.

3. Science has only good impacts on people'

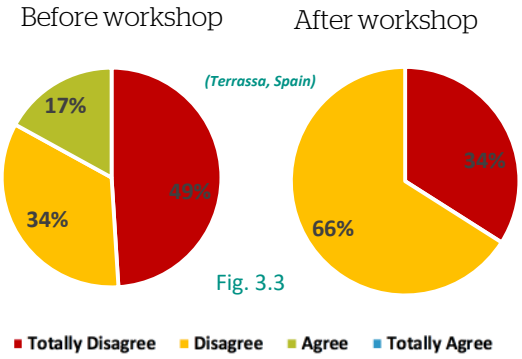


Fig. 3.3

In Terrassa, though not statistically significant (p>0.1), 17% of students prior to the workshop strongly agreed with the statement that science has only good impacts on people, while none agreed with the statement following the workshop.

In Vauréal, there were similar results; 15% agreed with the statement before the workshop, but none agreed after. In Bristol, disagreement increased, but there was also a small increase in agreement.

Stereotypes and gender

4. 'Men are better scientists than women'

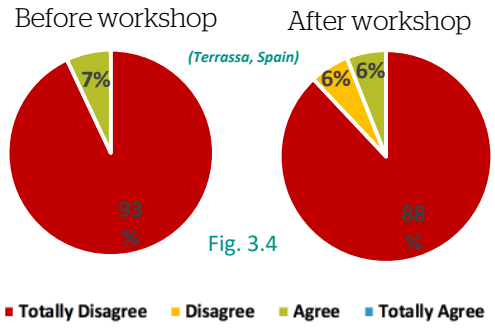


Fig. 3.4

One of the primary aims of PERFORM was to change young people's stereotypes about scientists. Results in Terrassa were statistically insignificant in this area (p>0.1). Students' responses generally showed a lack of gender-bias in their perception of science as most of them disagreed that men are better scientists than women both before and after the workshops.

In Vauréal, 6% of students agreed with the statement before the workshops, and all the students disagreed with it afterwards. In Bristol, agreement with the statement stayed the same before and after workshops, but neutrality decreased and disagreement with the statement increased.

Inspiration

5. *'I can see myself doing science in the future'.*

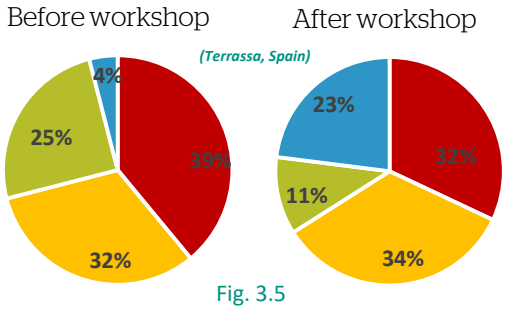


Fig. 3.5

One of the fundamental aims of PERFORM is to inspire young people to pursue science in greater numbers. In Fig, 3.5, we see that, although not statistically significant (p>0.1), after the PERFORM workshop in Terrassa, Spain, there was an increase of 5% in the number of participants who could see themselves doing science in the future. Strong agreement increased from 4% to 23%.

Similarly, at the workshop in Vauréal, there was an increase in agreement of 11%., In Bristol, the UK, both agreement and disagreement decreased, and neutrality increased.

Qualitative Evaluation of the Workshops

PERFORM researchers found that young people responded with energy and enthusiasm to the PERFORM workshops, and in particular the performance activities.

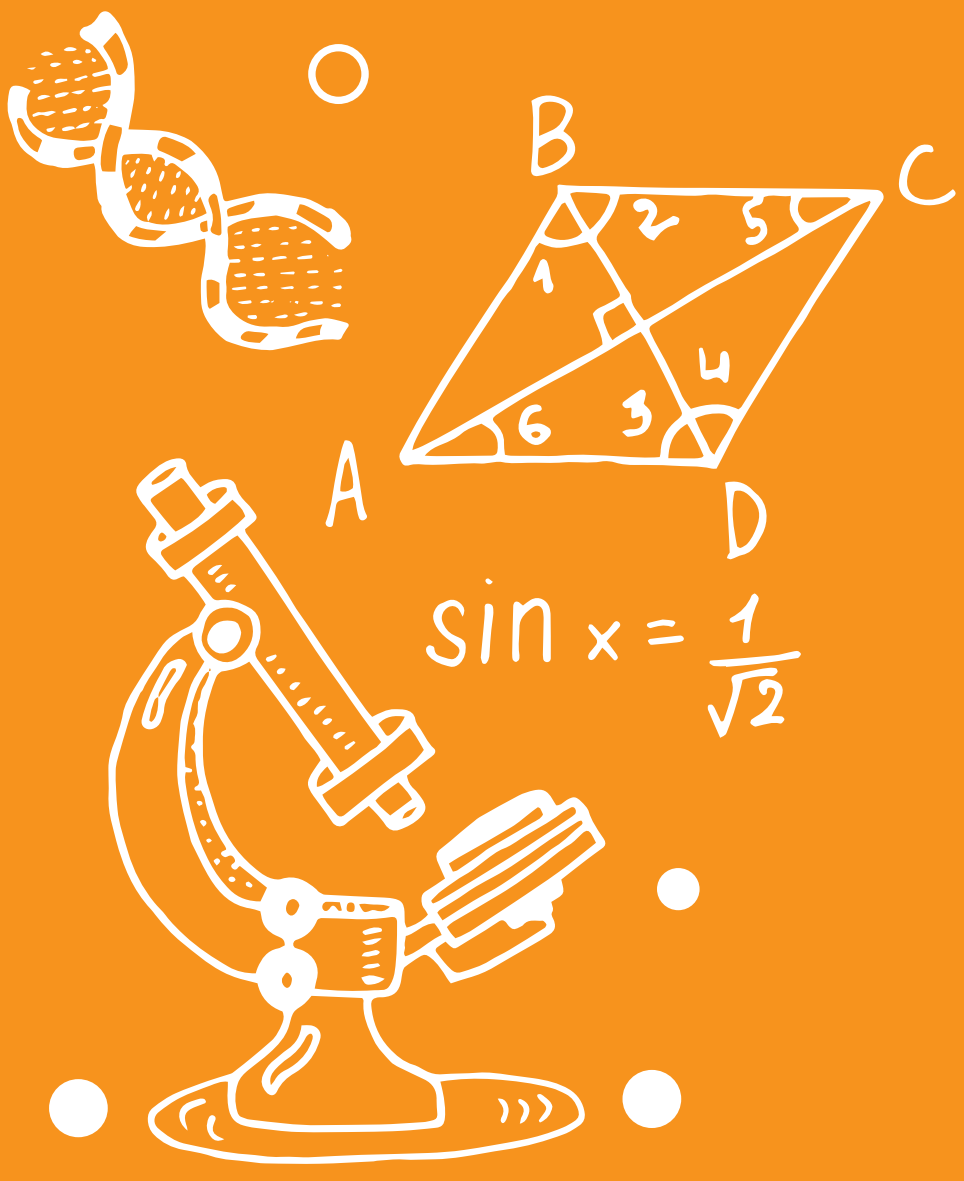
It was found that at the workshops in Barcelona, Spain, which included those in Terrassa and also workshops in Castellbisbal, "students felt positive about their active participation in the project and felt included in the group: they felt their work was recognised and dialogue had been fostered...facilitators created a relaxed and comfortable atmosphere, which facilitated inclusiveness." In Vauréal, France, Students were "highly engaged in the workshops", and engagement increased further when students saw that the activities led towards a final performance. In the UK, students enjoyed contributing to the design of busks and practicing them, but some students felt shy about performing.

Teachers in Barcelona appreciated the capacity of PERFORM to engage students who usually do not participate in academic tasks. However, they also recognised some challenges for performance-based activities; they found that scientific content of the workshops was not sufficiently developed, and occasionally felt superficial.

By working through arts-based techniques to approaching scientific issues alongside ECRs and teachers, it was found that the learning process became:

- Participatory: young people were actively involved in the process of learning, alongside early career researchers and science communicators. They were no longer passively receiving information in a unidirectional, vertical transfer of knowledge.
- Contextualised: performance-based science activities took local issues into account, highlighting the particular relevance of science in personal and local domains.
- Humanised: performance activities emphasised the human elements of science, revealing the persons who are behind research, and connecting young people with them directly.
- Trans-disciplinary: performance-based activities recognised that science and scientific research takes place located within the world, and connected to many other issues and concerns. Through performance-based activities, young people considered questions of ethics, questions related to RRI values such as gender equality, and the role of the person in scientific research.
- Engaging: above all, learning science through performance-based activities was found to be fun, stimulating and intellectually engaging.

Ch. #4 Policy Implications and Recommendations



> Promoting new forms of interactions between teachers and students

From the results presented in the previous section, we can see that from performance-based science education activities, combined with valuable interactions with prepared teachers alongside early career researchers, young people:

- showed increased levels of engagement and interest with science and science-related issues;
- reduced their acceptance of some previously held negative stereotypes about scientists;
- improved their understanding of RRI values, and developed their awareness of broader questions relating to science.

PERFORM researchers found that the role played by teachers was key to making sure that performance-based activities appropriately fit local schools and their science curricula, and was important in helping to facilitate activities.

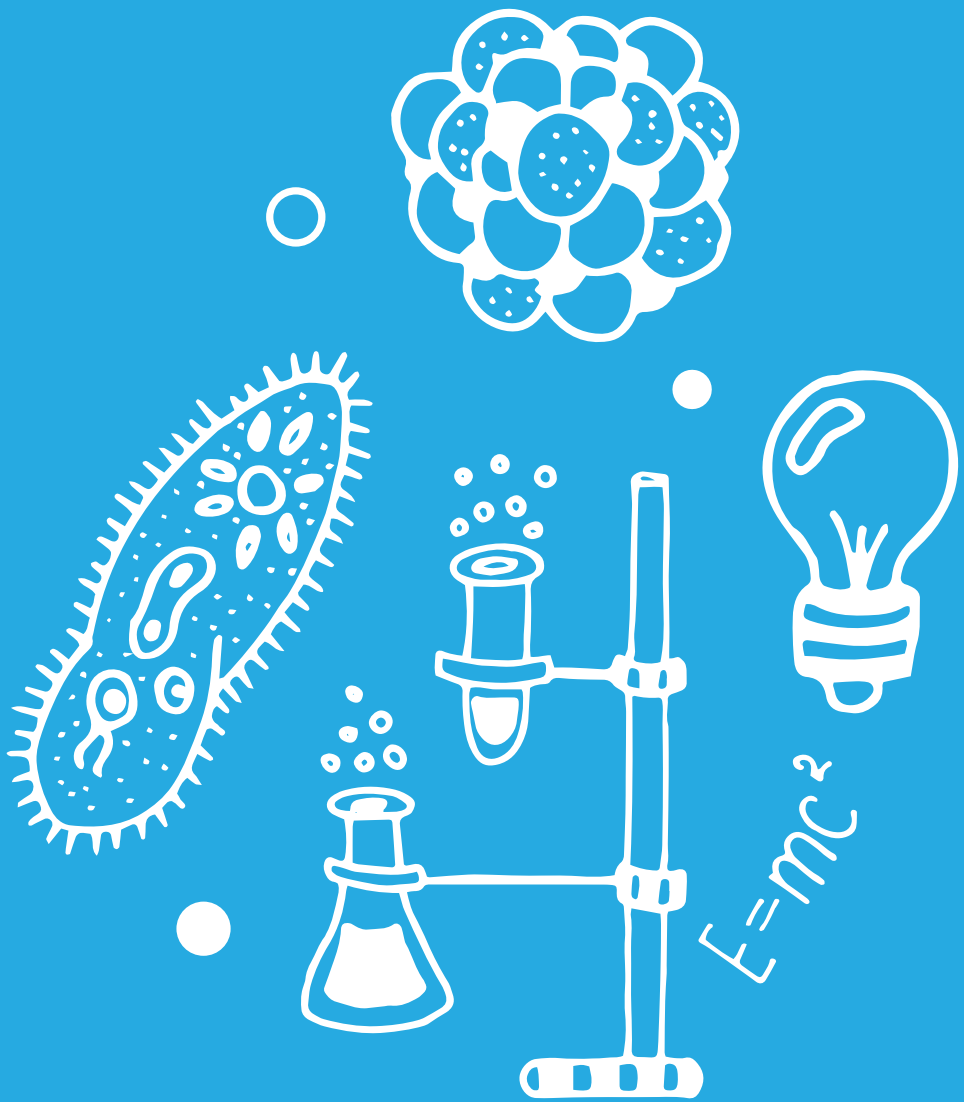
PERFORM therefore recommends that European policymakers should:

- Include in teacher-training curricula an emphasis on communication, performance, reflexivity and RRI. Promote and disseminate resources such as PERFORM toolkits to support development programmes, and raise awareness of RRI in teacher-training institutions.

- Establish networks and official channels of communication to facilitate and encourage interactions between teachers in secondary schools, ECRs at higher education institutions, and science communicators. Support and foster the development of a common-culture of reflective performance-based participatory learning.

- Encourage and promote the use of performance-based pedagogy and activities that stimulate thinking about RRI issues in school curricula, fostering students' reflective engagement with STEM by humanising, contextualising and making more participatory the science-learning process.

Ch. #5 Project Identity



> Project Name: Participatory Engagement with Scientific and Technological Research through Performance (PERFORM)

Coordinator

Isabel Ruiz-Mallén

Universitat Oberta de Catalunya – UOC – Barcelona, Spain

Consortium

Universitat Oberta de Catalunya – UOC – Barcelona, Spain

Universitat Autònoma de Barcelona, UAB, Barcelona Spain

University of Bristol – UOB – Bristol, United Kingdom

University of Warwick – UOW – Coventry, United Kingdom

The Big Van Theory – TBVT – Castellbisbal, Spain

Science Made Simple – SMS – Cardiff, United Kingdom

Atelier de Jours à Venir – AJA – Paris, France

United Nations Educational, Scientific and Cultural Organization – UNESCO – UNESCO - Paris, France

Théories et Réflexions sur l'Apprendre, la Communication et l'Éducation Scientifiques – TRACES – Paris, France

Europaische Gesellschaft fur Wissenschaftsveranstaltungen – EUSEA – Vienna, Austria

EU contact

Zakaria Benameur. Email: zakaria.benameur@ec.europa.eu

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Website

http://www.perform-research.eu

For more information

Contact Dr. Isabel Ruiz-Mallén. Email: iruiz_mallen@uoc.edu

SCIENCE

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