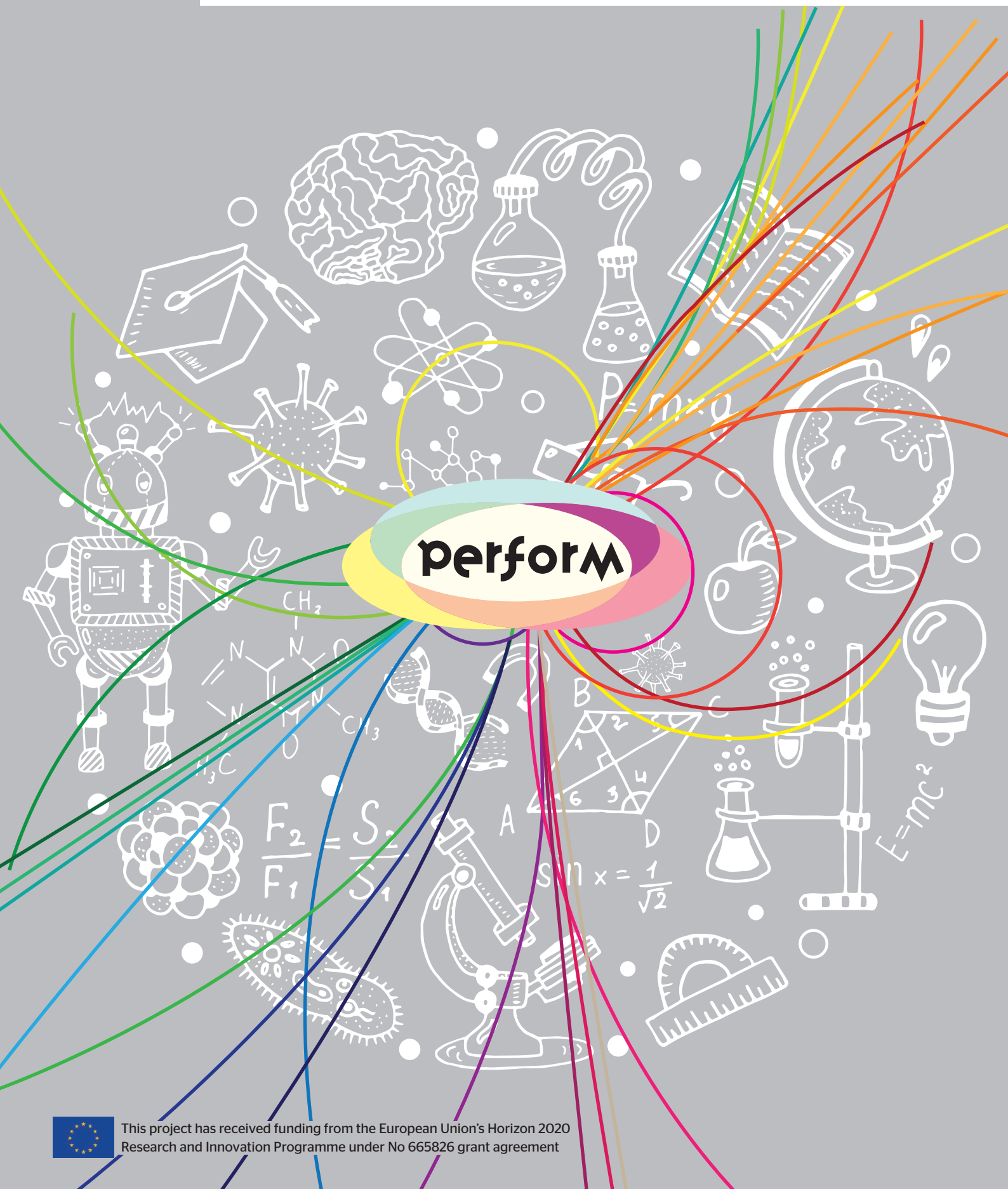
Policy Brief

Participatory Engagement with Scientific and Technological Research through Performance

#1

Policy recommendations on the role of early career researchers in motivational educational processes in STEM: the findings of the PERFORM project



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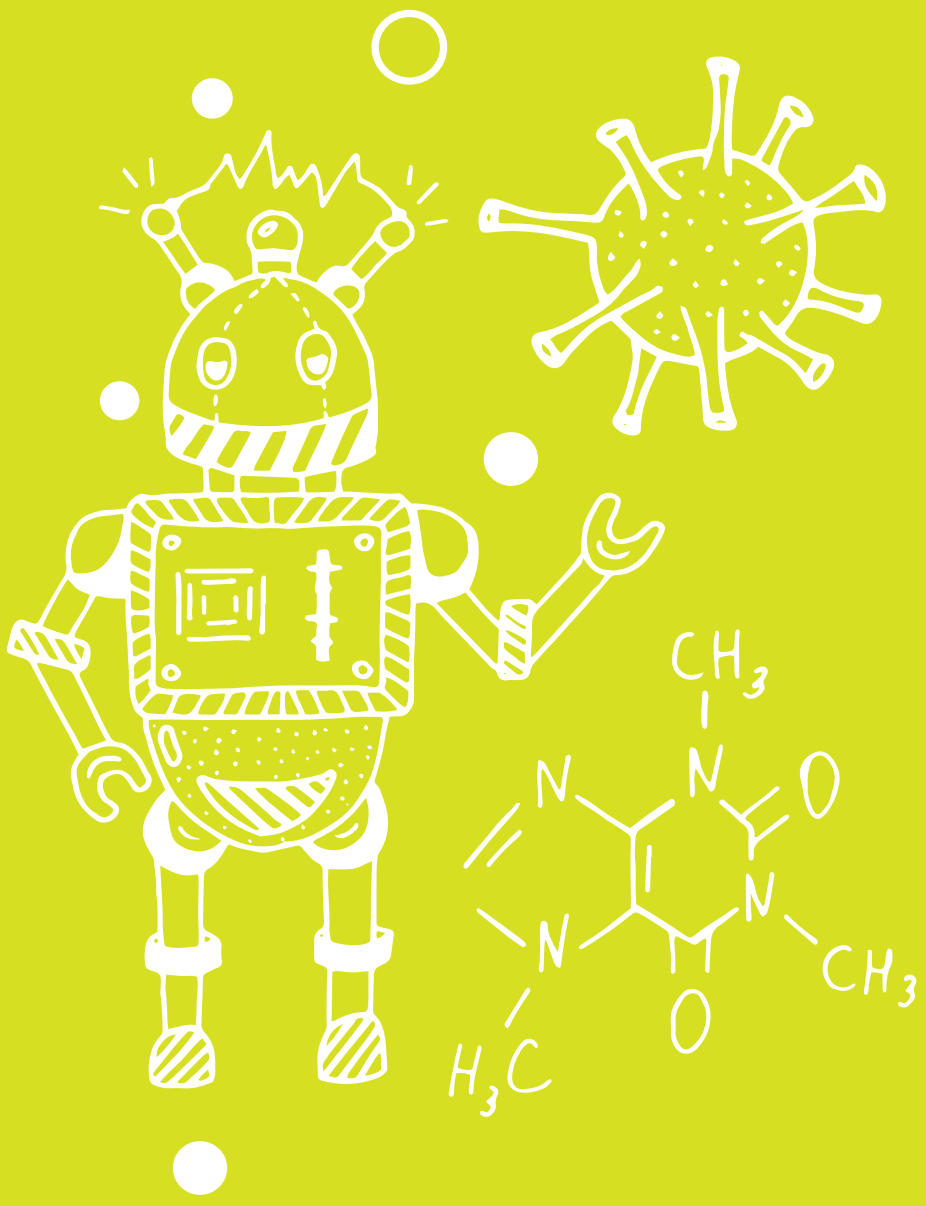
Ch. #1 Introduction



> 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.

Recent studies[1] suggest that young people are influenced by negative stereotypes and problematic cultural images of scientists. Stereotypes can dissuade young people from pursuing science, as they can consciously or subconsciously believe that science is not 'for' them. Interacting directly with young people in performance-based science education workshops, ECRs can help to nullify young people's stereotypes about scientists, by showing that people of all genders, ages and ethnicities are and can be scientists.

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.

Early career scientific researchers (ECRs) played a fundamental role in the PERFORM project. They were given holistic and multidimensional training, allowing them to develop cross disciplinary skills such as communication and engagement skills, team working abilities, and an understanding and appreciation of Responsible Research and Innovation (RRI) values. Once trained, early career researchers were then given the opportunity to interact directly with young people in workshops, collaborating together to develop performance-based science education activities.

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 early career researchers in new educational processes to motivate, inspire, and encourage reflection from young people, based on the findings and values of the PERFORM project.

[1] Ruiz-Mallen, I., Escalas, M.T. (2012), 'Scientists Seen by Children: A Case Study in Catalonia, Spain', *Science Communication, 34*(4), 520-545.;

Cheryan S., Master A. and Meltzoff A.N. (2015), 'Cultural stereotypes as gatekeepers: increasing girls' interest in computer science and engineering by diversifying stereotypes', *Frontiers in Psychology* 6: 1-8.

Ch. #2 The Role of Early Career Researchers in PERFORM

The involvement of early career researchers (ECRs) in performance-based science education workshops

PERFORM designed and conducted a participatory and inclusive process in which secondary students, alongside their teachers and early career researchers, developed their own science performances in a series of PERFORM workshops. These were based on three main performance formats: science monologues in Spain, busking in the UK and improvisation and clowning in France.

The workshops took place over two rounds, involving a total of 253 students, 30 teachers and 44 early career researchers. Based on learning from the first round, workshops were improved for the second, fine-tuning the sessions to local particularities, and emphasising certain RRI aspects.

Working together with young people, ECRs acted as intermediaries between students and science communicators, built relationships, trust and empathy with students, and brought with them personal knowledge and scientific experience. These interactions allowed young people and researchers to consider together RRI questions and concerns, and provided the opportunity for young people to come face to face with 'real' scientists.

ECRs asked guiding questions, encouraged young people to think critically about science and RRI values, and served as friendly, kind and open representatives of the scientific community.

Supporting young people's engagement in STEM

By working together with young people in performance-based science education workshops, early career researchers can:

1. explain their research, raise important questions, give their inputs and partake in performance-based activities, contributing to the effective communication of science to young people;

2. help challenge young people's stereotypes about scientists, by showing that people of all genders, ages and ethnicities are and can be scientists. They are able to reveal the 'human' side of scientific research, showing that scientists can be warm, approachable and social people; and

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

A toolkit to train ECRs

From 2016-18, PERFORM delivered two rounds of bespoke training courses for ECRs in Bristol, Paris and Barcelona. From this experience of training researchers, the University of Bristol coordinated the development of a toolkit which is available to higher education institutions to help train ECRs, and for ECRs to use independently.

The primary aim of the toolkit is to:

1. Prepare ECRs to collaborate effectively with young people in schools on performance-based activities, and to reflect with them on current research and RRI values.

In order to achieve this, the toolkit:

2. Supports ECRs in building a more holistic, reflexive and interdisciplinary understanding of their own research practice, taking RRI values into account.

3. Helps ECRs develop their communication, outreach and leadership skills.

The toolkit covers the following topics:

1. Research Ethics and Integrity
2. Reliability of Scientific Knowledge
3. Wellbeing at Work
4. Values in Science
5. Reflexivity in Research
6. Responsible Research and Innovation
7. Performance Approaches for Exploring Responsible Research and Innovation

The toolkit introduces each topic and offers activities for exploring the relevant issues. ECRs are encouraged to read material before training sessions, and then discuss the issues together in a structured format.

As part of the emphasis on RRI, ECRs are encouraged to consider how personal identities and background can affect research, and how they can respond to an awareness of themselves as 'situated' researchers.

ECRs are invited to consider the importance of public engagement, so that members of the general public are cognisant of the latest developments in scientific research, and so that scientists are receptive to public views about these developments.

The toolkit offers performance approaches and techniques to explore public engagement, emphasising narrative and storytelling as a means of bringing science to life.

Benefits of training to ECRs

For many ECRs, PERFORM training constituted the first formal opportunity to reflect on RRI values and questions, and develop essential skills to communicate effectively with young people and the wider public. At PhD level, there is no obligation to develop these skills and formally consider these questions, and higher education institutions often provide no formal structure or framework within which to do so.

The PERFORM project produced evaluations of ECR training over the two years of courses. ECRs reported that training helped them become better equipped for thinking reflexively about their research and about scientific practice. They reported that they had developed conceptual frameworks to look at science and their own research with 'a new lens', improved their linguistic and listening skills, and benefited from developing meaningful relationships with students.

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 Vauréal, France, which we compare to our experiences from the same round in Terrassa, Spain, and Bristol, UK. These results may not always be representative of all of our experiences in the France, Spain and the UK, but they do reflect general patterns which show the potential of our approach. In one case, we show aggregated results from the second round of workshops.

The data shown from Vauréal represent the 19 students in the PERFORM group who answered a questionnaire before and after workshops. The Vauréal control group was made up of 31 students. The data from the workshops in Terrassa and Bristol represent the answers of 33 students and 19 students respectively.

It was found that as a result of PERFORM 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. Additionally, data suggest that the involvement of early career researchers in the workshops was successful.

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 early career researchers

One way of measuring the effectiveness of the interactions between ECRs and young people is by analysing the extent to which young people felt satisfied with these interactions. Young people across the second round of workshops responded to the statements:

1 (a) *'I feel my work during workshops was recognised by the early career researcher'*

(b) *'I had little interaction with early career researchers during the workshops'*

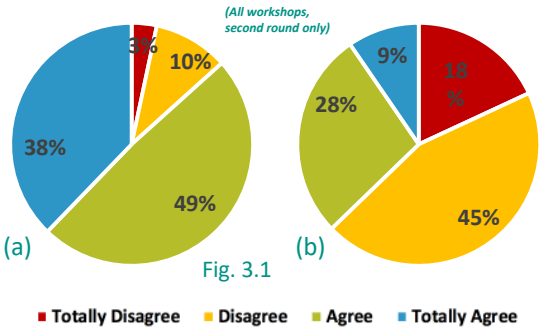


Fig. 3.1

87% of the students in the second round of workshops felt that their work had been recognised by their ECRs (Fig 3.1), and only 37% felt that they had little interaction with them.

Inspiration

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

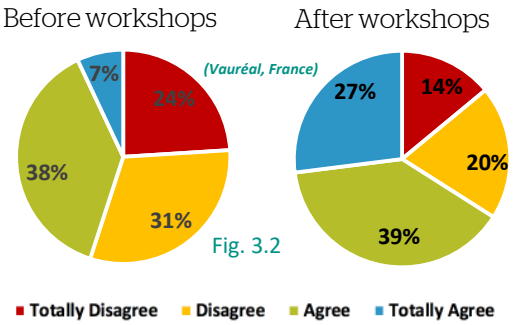


Fig. 3.2

In Fig. 3.2, we see that, while not statistically significant (p>0.1) after the PERFORM workshop in Vauréal, France, there was an increase of 11% in the number of participants who could see themselves doing science in the future.

Similarly, at the workshops in Terrassa, Spain, there was a small increase in agreement, and a small decrease in disagreement. In Bristol, the UK, both agreement and disagreement decreased, and neutrality increased.

Stereotypes and gender

3. *'Men are better scientists than women'*

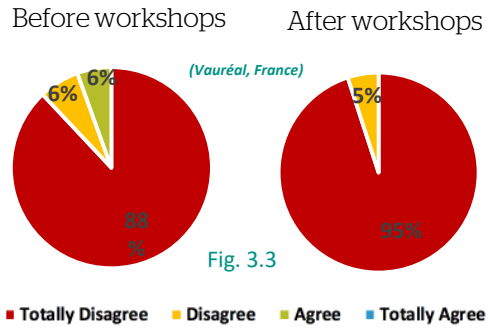


Fig. 3.3

Prior to the workshops in Vauréal, 6% of students agreed with the above statement. After the workshops, however, all the students disagreed with the statement. While this change is not statistically significant (p>0.1), the difference between before and after surveys is significantly different to the control group, who provided more positive answers in the 'post' survey.

In the workshops in both Terrassa and Bristol, agreement with the statement stayed the same before and after workshops, but neutrality decreased and disagreement with the statement increased.

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

4. *'Science will help me understand more about global issues'*

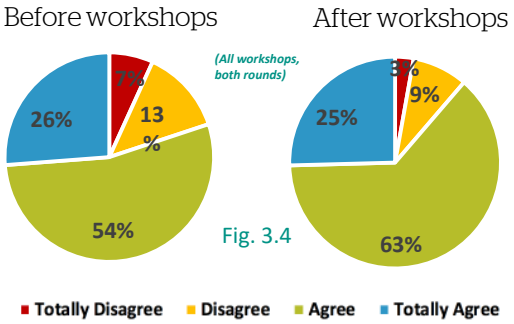


Fig. 3.4

In Fig. 3.4, we see that across all the workshops, there was an 8% increase in agreement with the view that science helps to understand global issues.

5. *Science has only good impacts on people'*

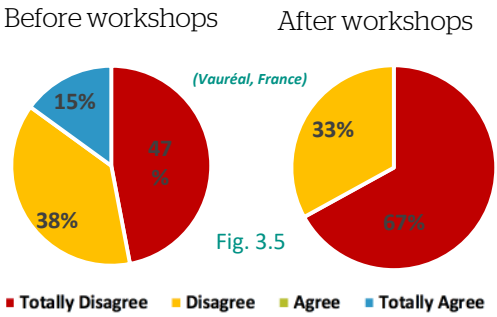


Fig. 3.5

In Vauréal, 15% of students prior to the workshops strongly agreed with the statement that science has only good impacts on people, while none agreed with the statement following the workshop. While variation between the surveys was not statistically significant (p>0.1), there was a significant difference with the control group, most of whom provided a neutral answer.

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 the workshops in Vauréal, France, "showed a high degree of inclusiveness, with a gender balanced involvement of students". Students were "highly engaged in the workshops", and engagement increased further when students saw that the activities led towards a final performance. Similarly, in Spain it was found that "students felt positive about their active participation in the project and felt included in the group...in both schools, facilitators created a relaxed and comfortable atmosphere, which facilitated inclusiveness". In the UK, students enjoyed contributing to the design of busks and practicing them, but some students felt shy about performing.

Working in the other direction, ECRs gained experience explaining scientific concepts to young people, and getting involved in broader debates. In this way, the workshops generated a mutual learning environment between scientific and educational communities.

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

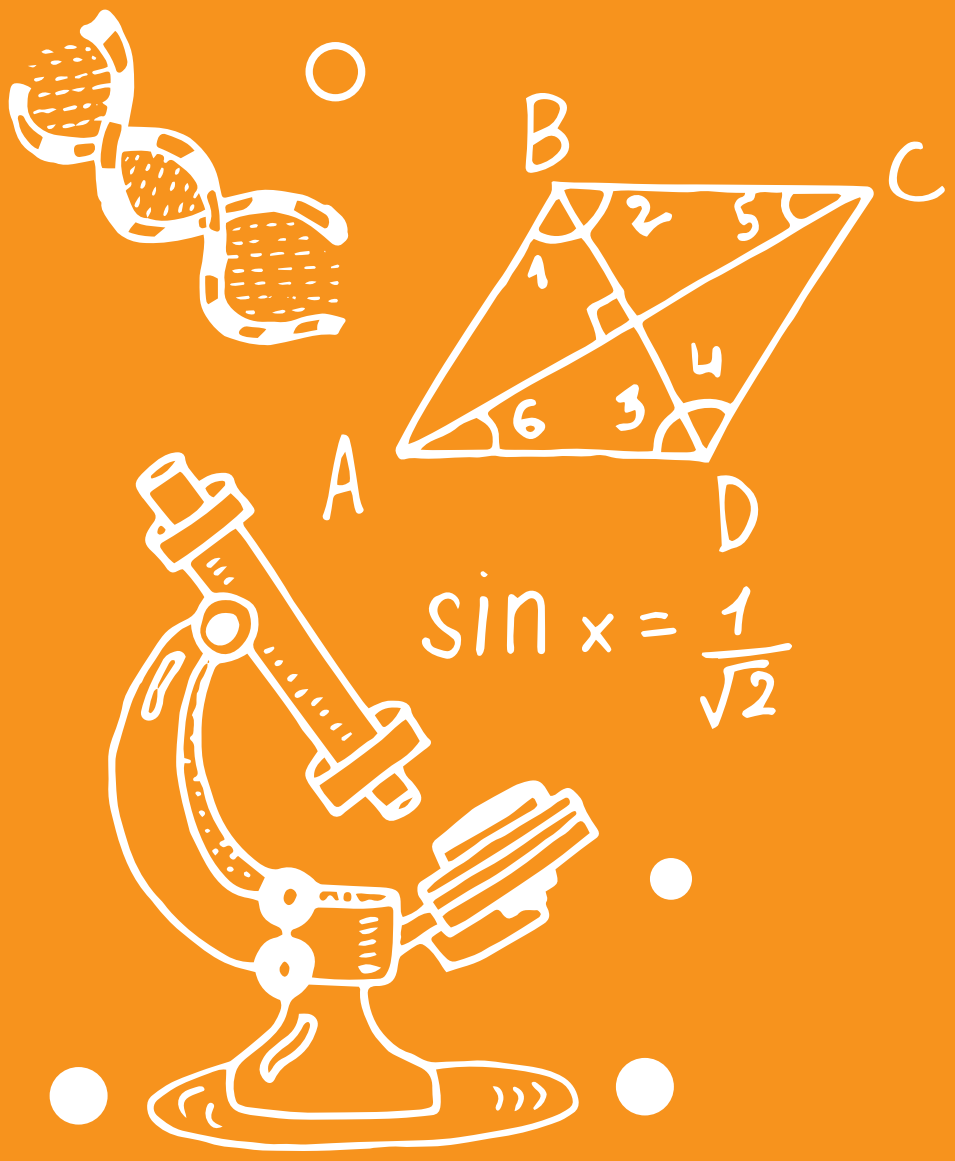
- Participatory: young people were actively involved in the process of learning, alongside early career researchers and science communicators. They were no longer passively receiving information in a unidirectional, vertical transfer of knowledge.
- Contextualised: performance-based science activities 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.

> ""What I liked the most has been the **enjoyment** and the **laughs** we all shared in the workshops, and the **enthusiasm** of the facilitator towards us. I really liked his presence during the workshops" – female student, Spain

> "When we were working on our different themes...honestly, it was awesome, **it made us think**" – female student, France

Ch. #4

Policy Implications and Recommendations



> Promoting interactions between early career researchers and young people

From the results presented in the previous section, we can see that from performance-based science education activities, combined with valuable interactions with trained 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.

Young people also largely reported feeling satisfied with their interactions with ECRs, and it was found that their involvement in workshops was effective in helping to change young people's stereotypes about scientists.

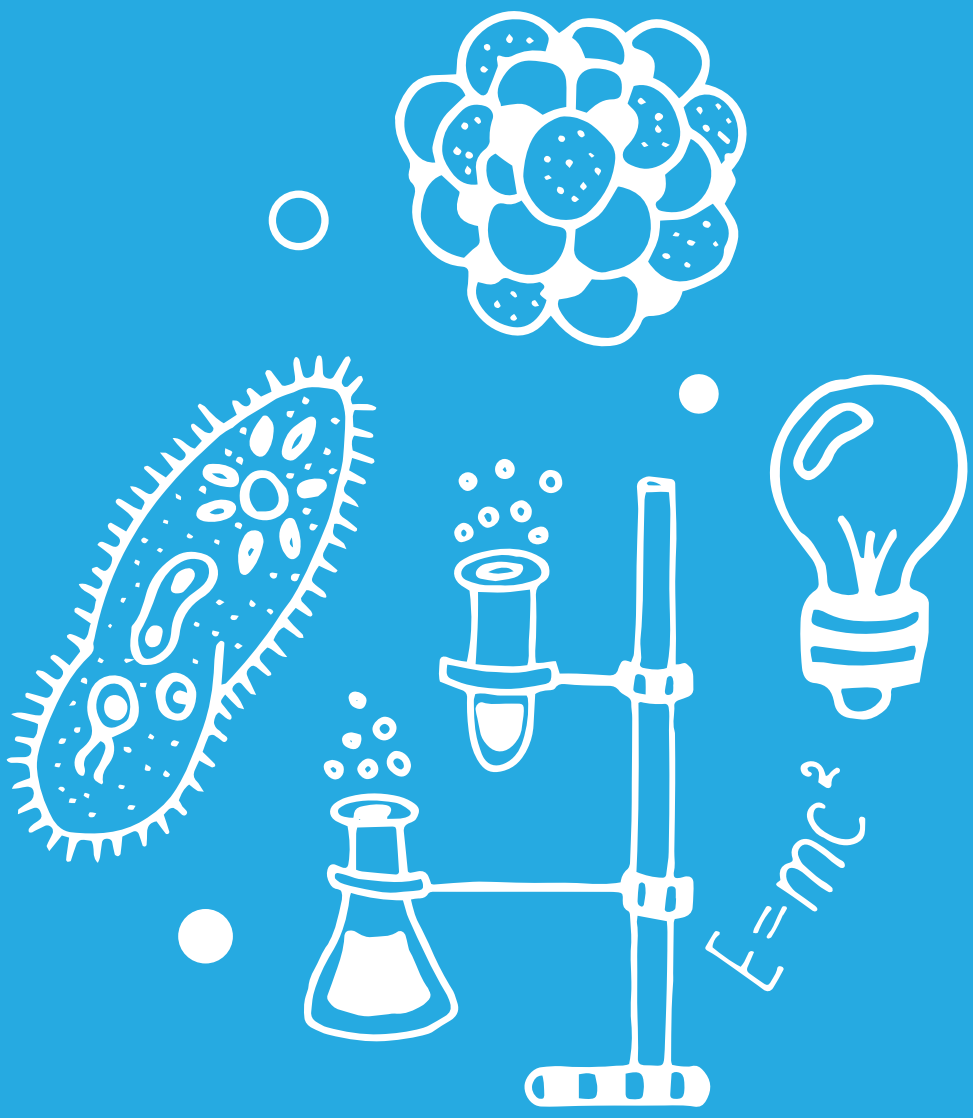
PERFORM therefore recommends that European policymakers should:

- Encourage higher education institutions (HEIs) to provide programmes of professional development for ECRs which include training on communication, performance, reflexivity and RRI. Provide incentives to ECR supervisors to release ECRs for this training. Promote and disseminate resources such as PERFORM toolkits to support development programmes. Raise awareness of RRI at all levels in higher education institutions.

- Establish networks and official channels of communication to facilitate and encourage interactions between ECRs at higher education institutions, teachers in secondary schools, and science communicators. Support and foster the development of a common-culture of reflective performance-based participatory learning. Encourage HEIs to build on the progress that they have made with outreach and engagement, particularly with schools operating in low socio-economic contexts.

- Encourage and promote the use of performance-based pedagogy and activities that stimulate thinking about RRI issues involving trained ECRs in school outreach, 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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