



Deliverable No. [D.5.2]

Two policy briefs on WP5 related topics

Project acronym:
PERFORM

Project Title:
Participatory Engagement with Scientific and Technological Research through Performance

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Authors: Casimiro Vizzini, Alex Da Silva, Jake Lewis, Giulia Bussoletti (UNESCO)

Peer-reviewed by: Eric Jensen (UoW), María Heras Lopez (UAB), Isabel Ruiz Mallen, Paula Ximena Fernandez (UOC), Sarah Eagle, Jon James (UoB)

Deliverable 5.2 Two policy briefs on WP5 related topics

SUMMARY.....2

1. POLICY BRIEF #1.....3

3. POLICY BRIEF #2.....17

SUMMARY

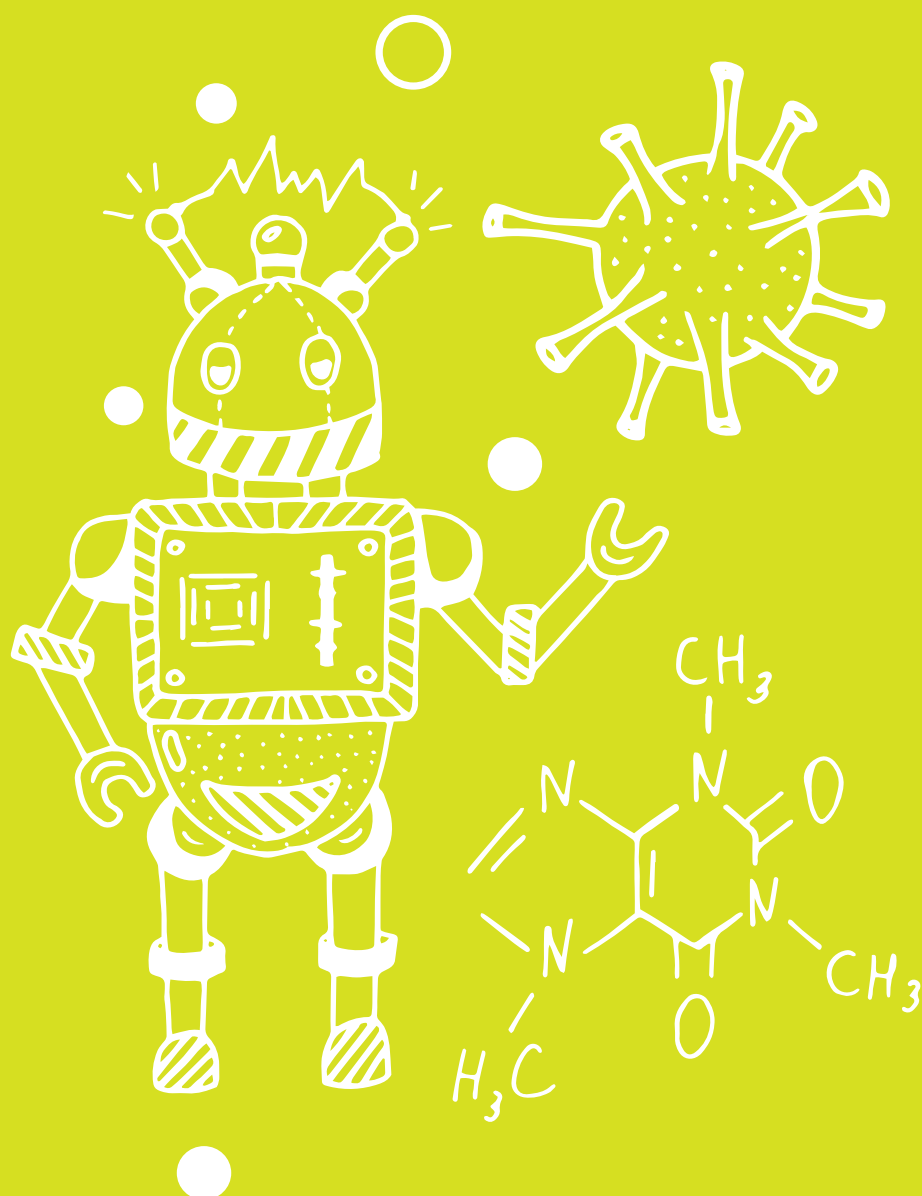
PERFORM is a European Commission-funded Horizon 2020 project centred on the development of innovative science communication tools in the performing arts, with the aim of inspiring and motivating young people to pursue Science, Technology, Engineering, and Mathematics (STEM) academically and professionally, while encouraging young people to develop a more reflective and holistic understanding of science. 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 more honest and transparent learning processes, to emphasise the human elements of science and research, and to help young people develop cross-cutting and critical skills. Early career scientific researchers (ECRs) and secondary school teachers played fundamental roles in these processes. Consequently, this deliverable includes two policy briefs relating to both early career researchers and teachers. The briefs offer, and make the case for the need for, policies to include early career researchers and teachers in new educational processes to motivate, inspire, and encourage reflection from young people, based on the findings and values of the PERFORM project.

#1

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



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 studies¹ 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 **cross-cutting 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.



>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.

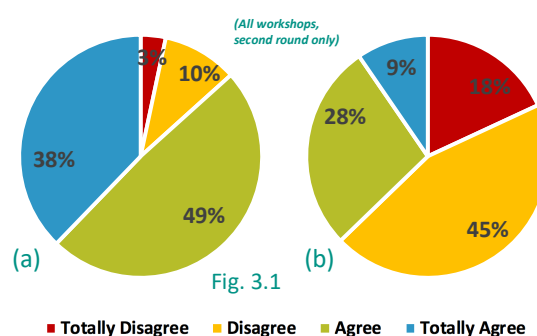
It was found that as a result of PERFORM workshops, young people showed **increased levels of engagement and interest** with science and science-related issues, and there was an improvement in young people's **understanding of the role of science and RRI values**. Additionally, data suggest that the 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:

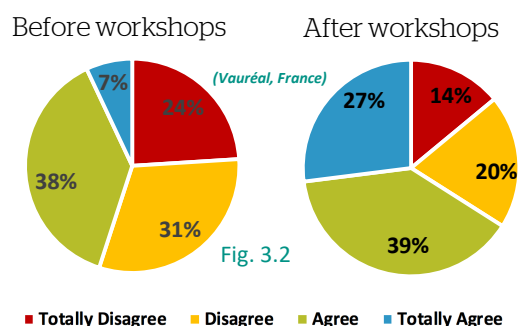
- 1 (a) *I feel my work during workshops was recognised by the early career researcher'*
- (b) *I had little interaction with early career researchers during the workshops'*



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'

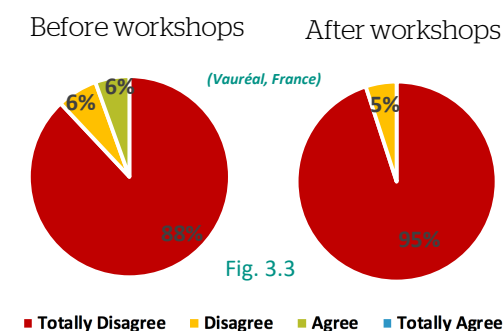


In Fig. 3.2, we see that, while not statistically significant ($p>0.1$) after the PERFORM workshop in Vauréal, France, there was an increase of 11% in the number of participants who could see themselves doing science in the future.

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'

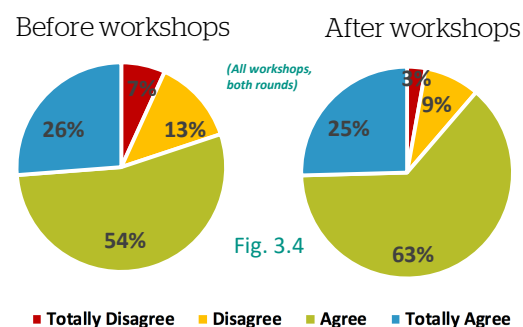


Prior to the workshops in Vauréal, 6% of students agreed with the above statement. After the workshops, however, all the students disagreed with the statement. While this change is not statistically significant ($p>0.1$), the difference between before and after surveys is significantly different to the 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.

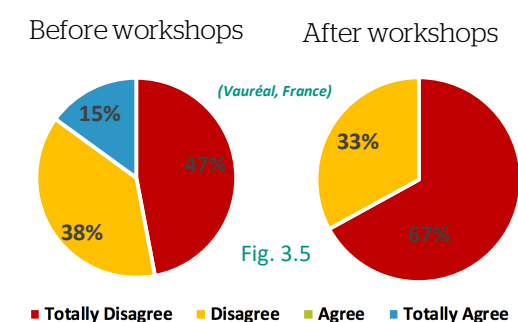
Understanding science and RRI values: the utility, methods and ethics of science

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



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'



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.

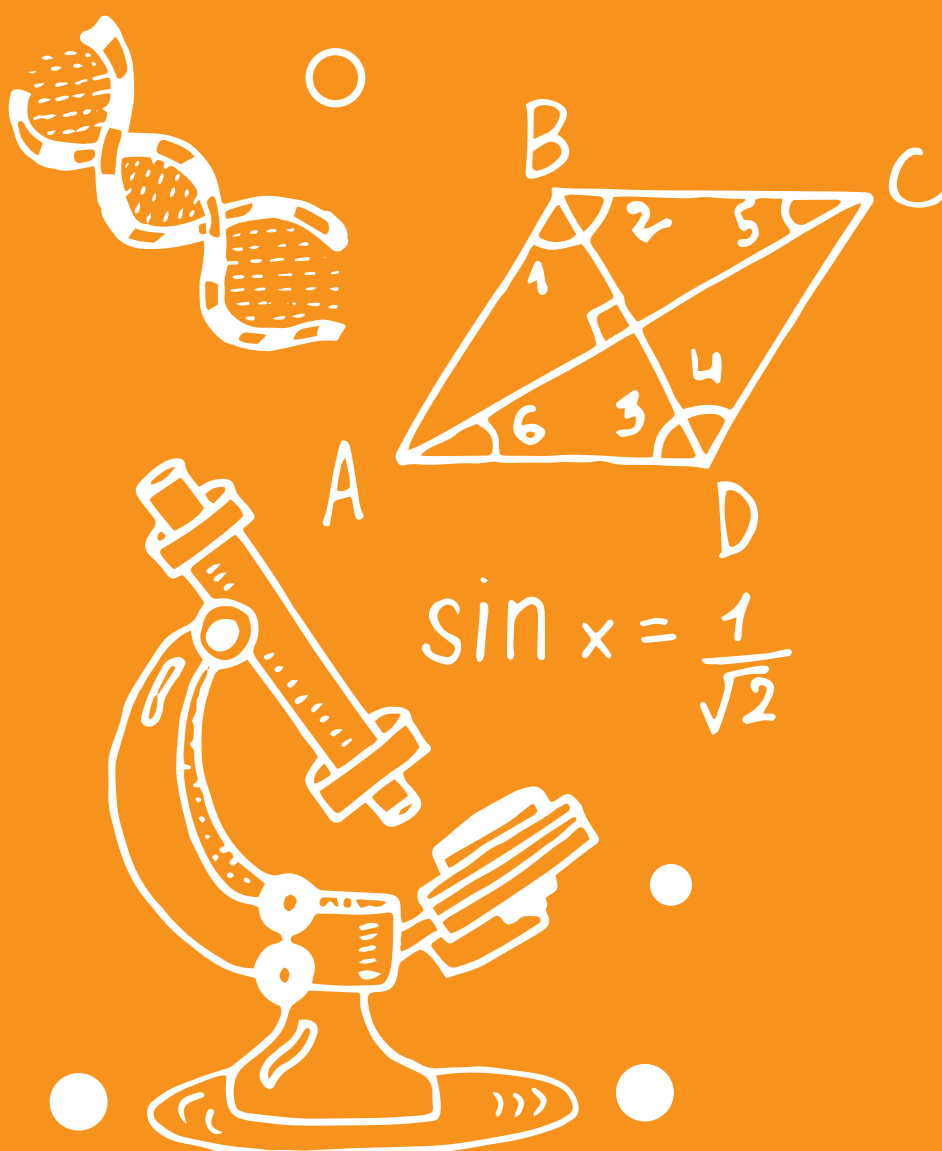
Working in the other direction, ECRs gained experience explaining scientific concepts to young people, and getting involved in broader debates. In this way, the workshops generated a **mutual learning environment** between scientific and educational communities.

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



> 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:

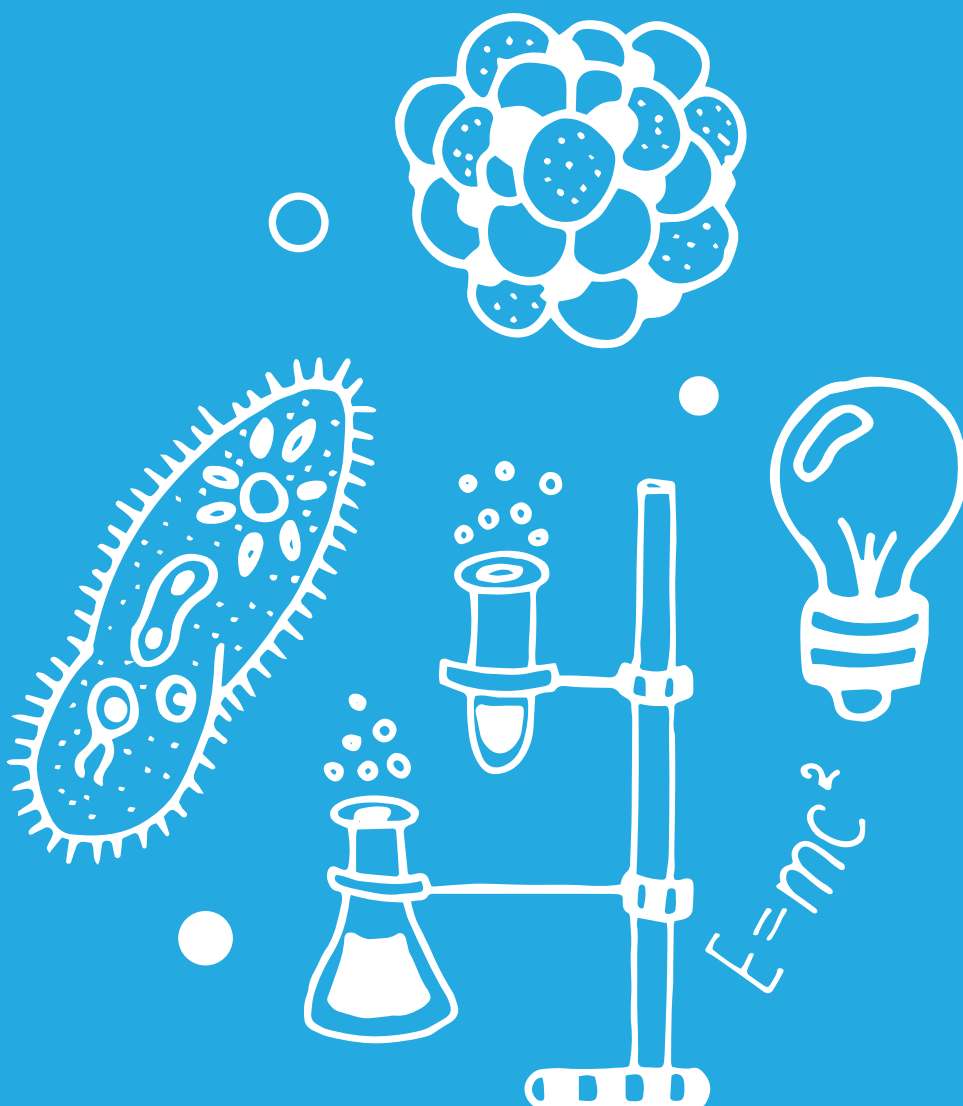
- showed **increased levels of engagement and interest** with science and science-related issues;
- **reduced their acceptance of** some previously held **negative stereotypes** about scientists;
- improved their understanding of **RRI values**, and developed their awareness of **broader questions**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

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

Europäische Gesellschaft für Wissenschaftsveranstaltungen - EUSEA - Vienna, Austria

EU contact

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

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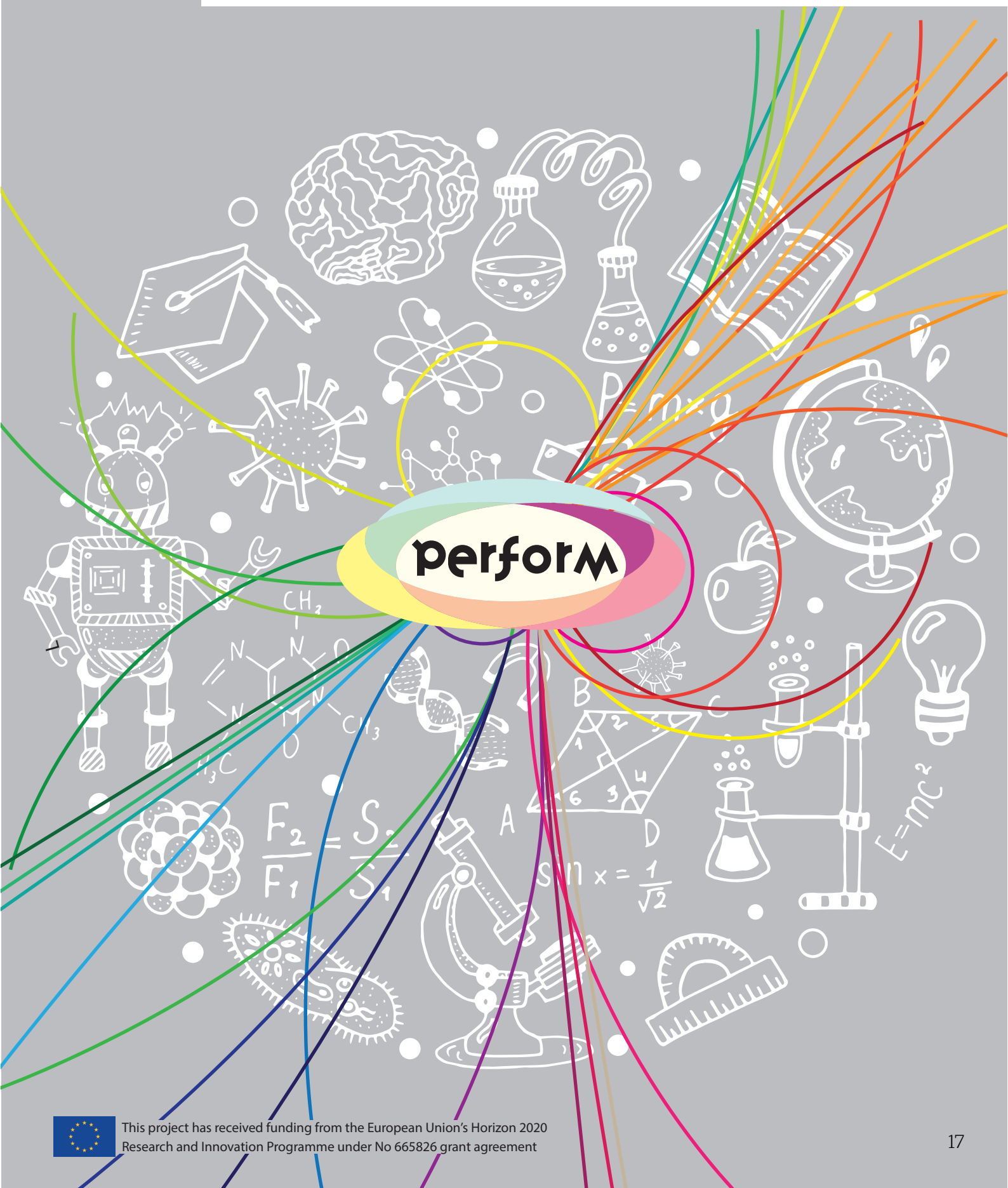
Website

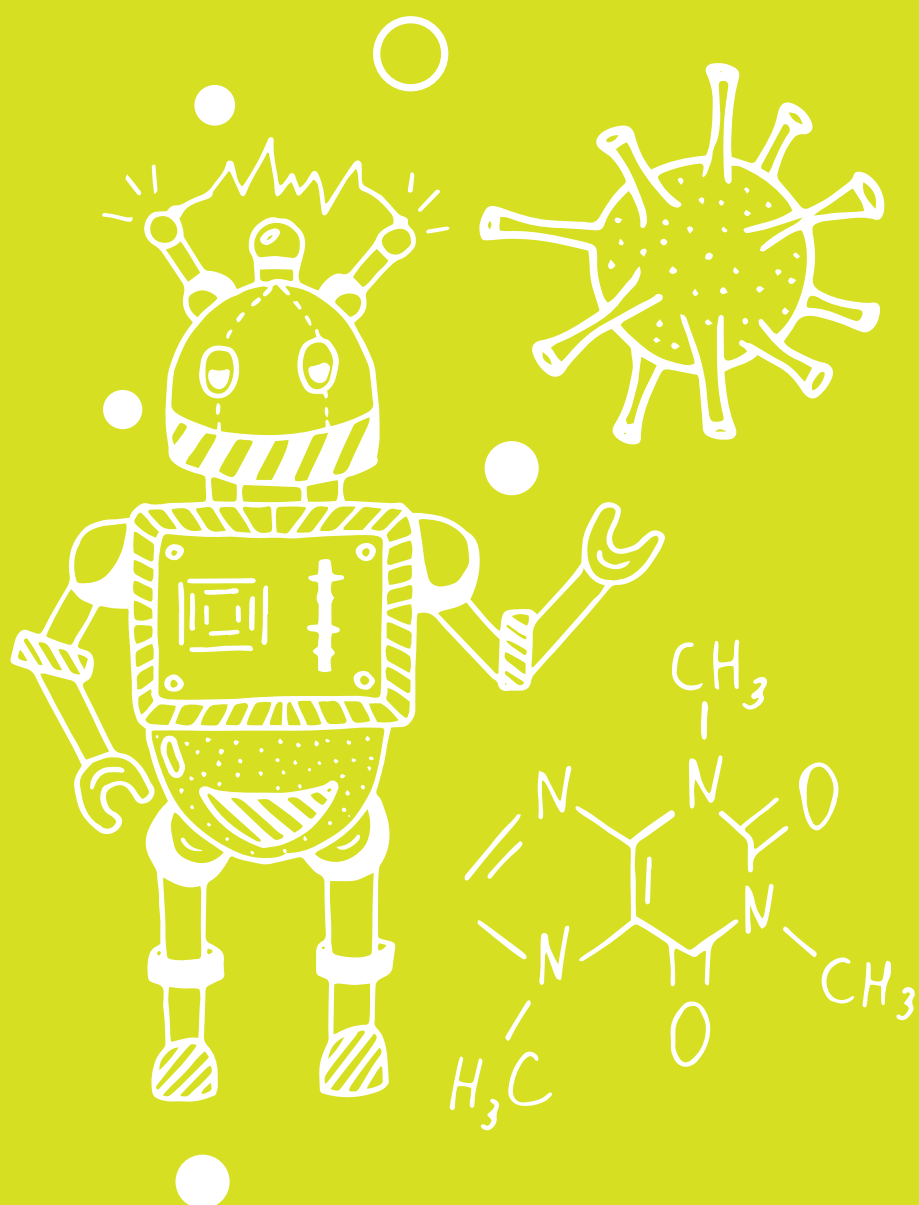
<http://www.perform-research.eu>

For more information

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

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





> 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 **cross-cutting 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 cross-cutting 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'

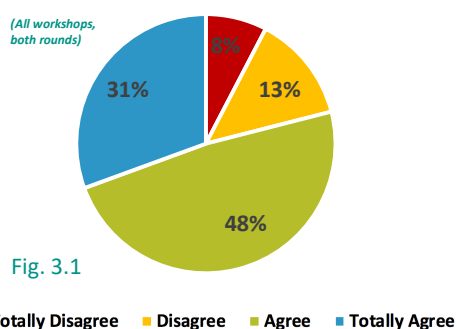


Fig. 3.1

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'

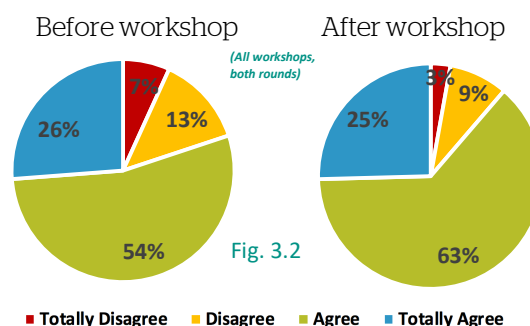
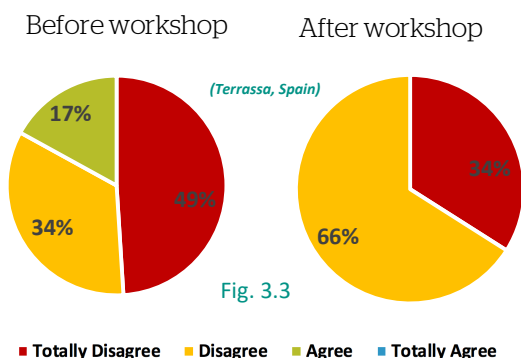


Fig. 3.2

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'

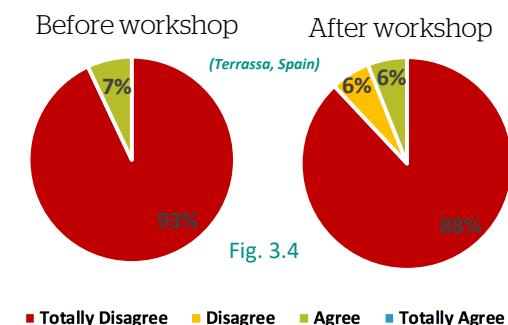


In Terrassa, though not statistically significant ($p > 0.1$), 17% of students prior to the workshop strongly agreed with the statement that science has only good impacts on people, while none agreed with the statement following the workshop.

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'



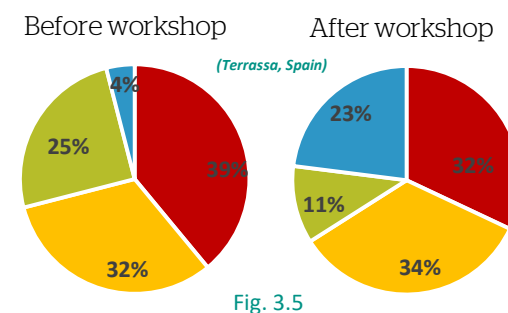
One of the primary aims of PERFORM was to change young people's

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'



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

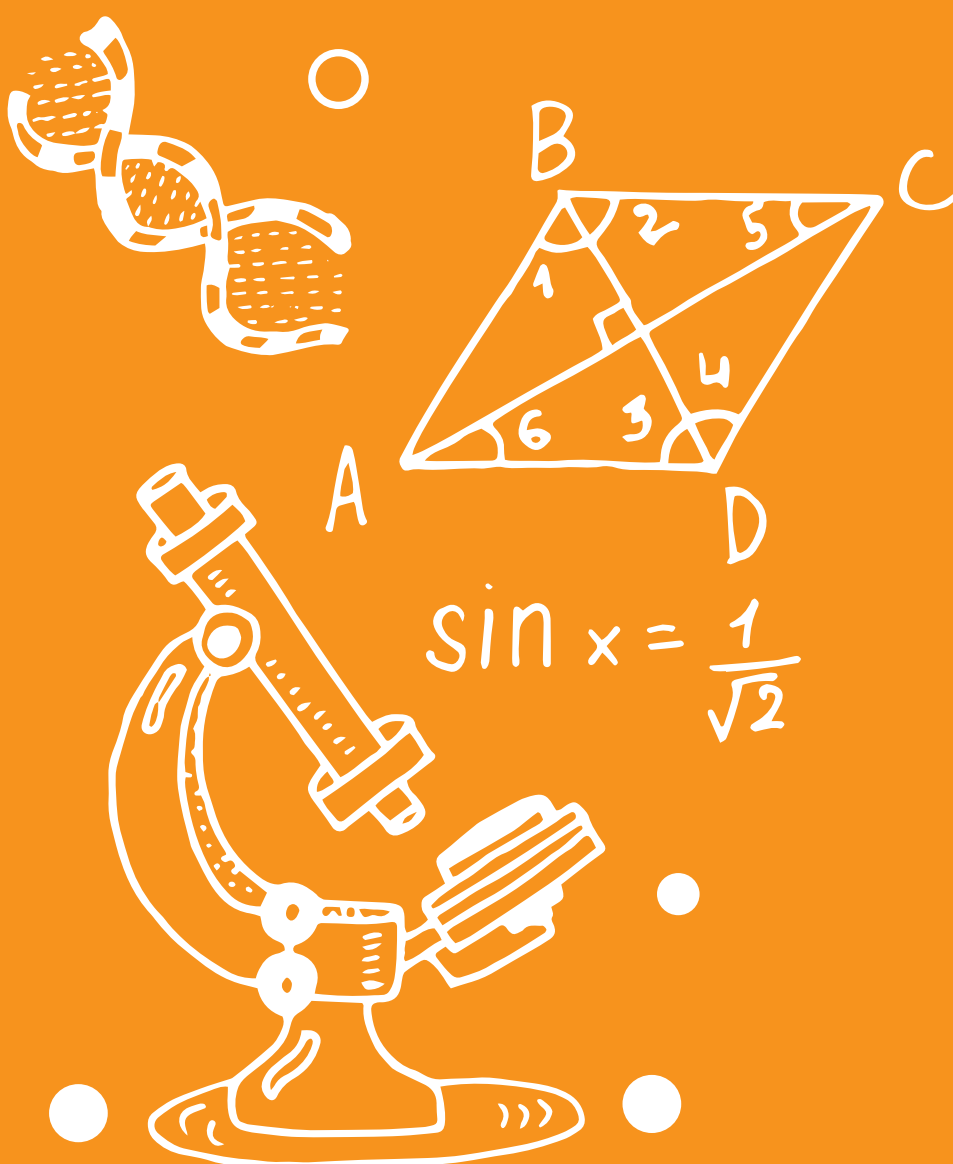
PERFORM researchers found that young people responded with **energy** and **enthusiasm** to the PERFORM workshops, and in particular the performance activities.

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**.



> 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:

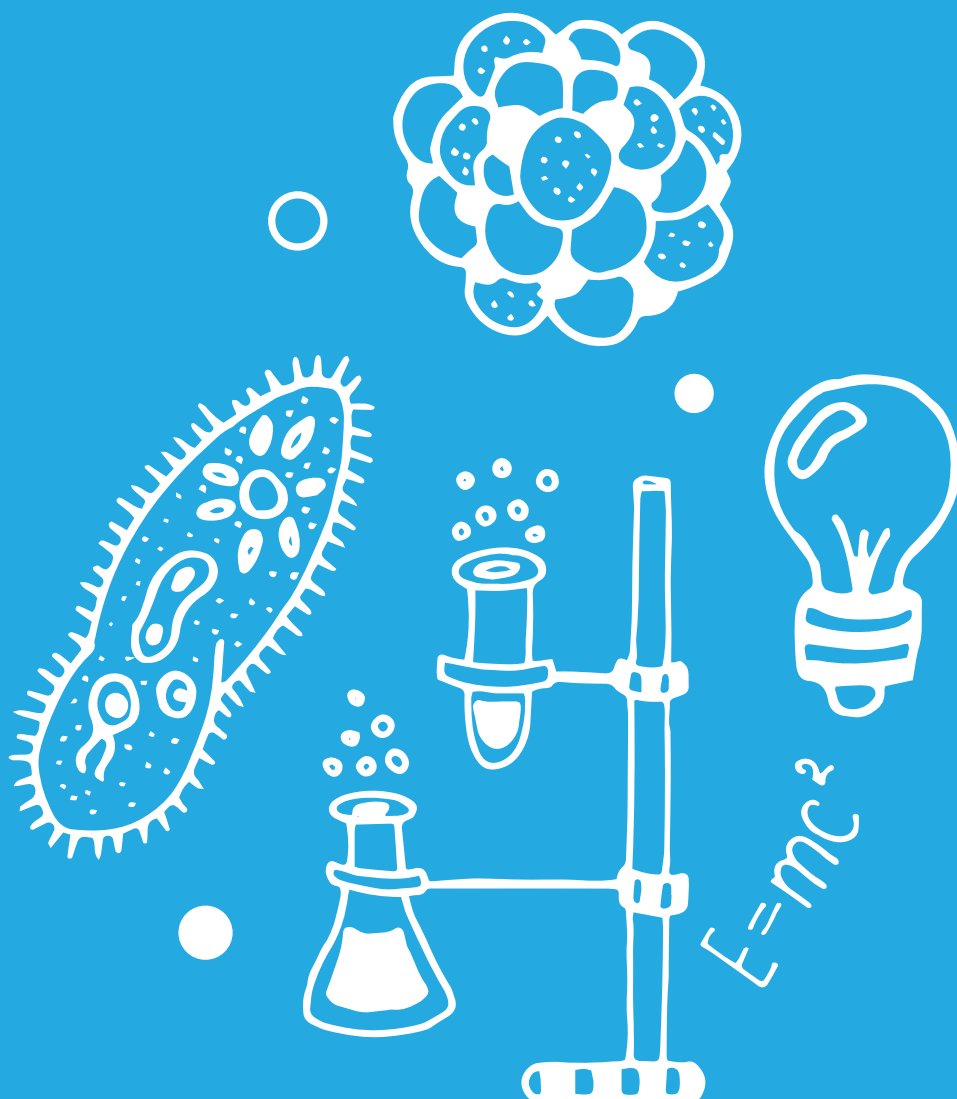
- showed **increased levels of engagement and interest** with science and science-related issues;
- **reduced their acceptance of** some previously held **negative stereotypes** about scientists;
- improved their understanding of **RRI values**, and developed their awareness of **broader questions**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

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

Europäische Gesellschaft für Wissenschaftsveranstaltungen - EUSEA - Vienna, Austria

EU contact

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

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For more information

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



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