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The PERFORM project: using performing arts to increase engagement and understanding of science

Abstract: This commentary describes some of the current challenges for science education in the UK and how an EU educational project (PERFORM) is seeking to use performing arts to engage young people with science, its values, and the processes of research.

Key words: collaboration, engagement, interdisciplinary, performing arts, STEM, science education,

INTRODUCTION: THE RISE OF STEM

Many Western countries, the UK included, have placed considerable political and financial emphasis in the last 20 years on the notion of STEM (Science, Technology, Engineering and Mathematics). These subjects have been bound together in a way that might help young people consider the values and purposes of scientific innovation and technological development in an integrated way (Pitt 2009). The inception of STEM appeared to afford opportunities for interdisciplinary working, with teachers encouraged to move out of their narrow subject areas, and adopt more innovative, collaborative approaches. In reality though the STEM agenda has proved controversial, rarely being linked to the aforementioned educational aims, with many arguing that it limits the purposes of science education and has exacerbated the perceived exclusivity of the subject (Blades, Weinstein and Gleason 2014; Carter 2008) .

Governments have hoped that the STEM approach to the curriculum would increase interest in STEM subjects at school, resulting in the production of more scientists and thereby enhance economic competitiveness. However the alignment of school science with the “STEM pipeline” may well be counterproductive, as there is evidence that some students are deterred from opting for science by its narrow, technical nature and seeming irrelevance to their career aspirations (Archer *et al* 2016). This resonates with studies showing that countries that have adopted a STEM agenda have often seen a drop in numbers opting for STEM subjects and a decline in performance in comparative international tests (Blackley and Howell 2015).

Recent changes to our National Curriculum for Science have reflected the influence of STEM (DfE 2013). The previous incarnation placed an emphasis on the social practices of scientists and the way that those scientists worked in the world, hence permitting space for considering the purposes and values of scientific innovation. However, in the current curriculum science is represented as more abstract, mathematical and objective in nature, supposedly to add academic rigour and increased likelihood of “success in our modern economy” (Gibb 2015). This narrowing of the Science curriculum resonates with studies showing that STEM subjects are rarely taught in integrated ways and that interdisciplinary approaches, applying science to real world problems, are not encouraged (Reiss and Holman 2007). Of interest to the readers of this journal would be the low prominence given to microbiology as a discipline, for example in the Key Stage 3 National Curriculum the only reference is to pupils being taught about “the process of anaerobic respiration in humans and micro-organisms” (DfE 2013,P.7), when it is an area that would provide a rich context for exploring applications and purposes of science. Hence young people have a narrow concept of science, not aspiring to pursue the subject in the future, with girls and those from low socio-economic backgrounds particularly susceptible to this lack of aspiration (DeWitt *et al.* 2013)

A REALIGNMENT OF SCIENCE EDUCATION

Given the questionable effectiveness of STEM in relation to both political and educational goals, there is an interest in reconceptualising science education. While technology and mathematics might appear to be the natural allies of science, there may be some value in aligning science education with the arts and humanities when considering how to encourage young people to be active participants in science education. Turn the clock back and we find periods in our history when arts and science were much more closely aligned as people engaged in a shared passion for observing, documenting, and experimenting on the world around them. Today, both place an emphasis on

phenomena; science aiming to make sense of those phenomena in an empirical and rational way, while arts seeks to portray and represent them.

There have been shown to be benefits as well to the use of performing arts in science (Abrahams and Braund 2012). It can make ideas and theories, particularly abstract and complex ones, seem more comprehensible to students as more active involvement in learning is engendered. Drama activities have often been employed in science lessons to facilitate students' understanding, for example, of electricity, or to model a process such as digestion. The conceptual gap between everyday experience and abstract, scientific explanations can seem intimidating to many students, but the performing arts can provide a helpful bridging in alleviating some of the discomfort students experience (Tytler 2007).

THE PERFORM PROJECT

Science and arts projects are becoming increasingly popular; sometimes as a way to reach new audiences who are not necessarily already engaged in science. But these projects tend to communicate scientific topics and issues in informal settings. PERFORM is an EU project that seeks to investigate the use of performing arts to promote innovative science education in formal learning contexts. It is framed by a participatory approach that facilitates interaction between students, teachers and early career science researchers, using performance-based, science education methods.

The project is somewhat unique in moving early career researchers beyond the "STEM ambassador" role, which traditionally involves transmission of expert knowledge, to one where their scientific knowledge and values are linked with students' experience, with the ultimate aim of humanising science. It is hoped that the later focus will increase engagement and participation in the subject, particularly among the groups identified above that struggle to identify with the subject on a cultural level. While aiming to increase students' learning about and engagement with science, it is importantly a means of helping young people to get a more realistic vision of scientific practice and challenge myths about science careers.

The PERFORM project is using an action research methodology that places students at the centre of the study. It is assumed that their active participation in the design, implementation, and evaluation of the research will result in changes in their beliefs and attitudes (Webb 1996), which may in turn lead to changes in behaviour regarding future participation in science. The research is being conducted in twelve secondary schools in France, Spain, and the UK between 2015 and 2018, with each country exploring a different performance approach. In France it is clowning, in Spain stand-up comedy, and in the UK street theatre. Performers from organisations specialising in those approaches are collaborating with school students, teachers, and early career researchers to devise performance activities that communicate science. The latter are at an early stage of development, but what is already evident is the interest that students are showing in selecting diverse scientific phenomena and stories for performance, and the willingness of those students, including those with a reputation for reticence, to participate and actively contribute. To give an example: one researcher is working on the links between gut bacteria and obesity, and students have developed a "busk" to convey the research process and its findings.

As part of the process teachers and early career researchers receive training that aims to develop communication and performance skills; this will be refined to enable production of training resources and toolkits. A critical area for the project to consider is how readily the pedagogical approaches being used as part of PERFORM would be taken up by teachers and incorporated into the classroom context.

As PERFORM is an EU Horizon 2020 project, it must be framed by responsible research and innovation (RRI) values. This is a significant dimension to the work as the research aims to move beyond merely increasing students' scientific knowledge to develop a more reflective knowing of science in which young people can consider purposes, values, and how science becomes reality. RRI values relate to transparency, ethics, and inclusivity, with the latter focusing on gender equality and participation of marginalised groups. So running alongside the

performance dimension is work to engage teachers and students with the ethical and philosophical dimensions of science and scientific research.

An interesting example, having the potential for development as a performance activity, would be that of Edward Jenner and his supposed “leap of genius” in developing vaccination. It is a story which rarely features with any prominence either a woman, Lady Mary Wortley Montagu, or the practices of non-Western scientists (Behbehani 1983). Lady Mary met with the practice of variolation whilst in Turkey and realised the potential of the process for treating smallpox. On returning from Turkey in 1721 Lady Mary set about publicising the method, but became a public target of misogynist prejudice. It is hence inconceivable that Jenner was not educated in this during his medical training, and prior knowledge of Lady Mary’s work makes the step he took seem both smaller and more scientifically justified. It’s a story that challenges the impression that science doesn’t belong to girls or to young people from Asian, Caribbean, African, or Arabic heritages; issues that resonate strongly with the PERFORM project.

SUMMARY

It is hoped that PERFORM can help us begin to explore the value in aligning science education with the arts when considering how to encourage young people to be active participants in science education. Key stakeholders see the project’s methodological innovation as essential to raise the attractiveness of science in formal educational contexts, yet it will be important that the unique collaboration between early career researchers, teachers and students, using performing arts, is seen as something that can enrich our science education and enable young people to come into new relationships with the subject.

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