ASE Presidential Address 2025: Mind the gap! Challenging inequalities in school science engagement and participation

Louise Archer, Professor of Sociology of Education at University College London (UCL), and ASE President 2024–2026, reflects on how we can create space for all teachers and students to learn and thrive in science

Reflecting back on the past year, it struck me that 2024 offered a rather mixed picture of the state of school science. As was widely reported, England's science scores improved in the latest TIMSS (Trends in International Mathematics and Science Study, 2024) international assessment, moving up to fifth in the league table of 70 participating countries. At the same time, the Royal Society published analyses of data from the 2023 Science Education Tracker, a national survey of the science education experiences and views of young people aged 11–18 (Hamlyn *et al.*, 2024). This report revealed a downward trend in students' science interest, confidence and aspirations, and a widening gender gap, with declining interest among young women.

So it seems that – the usual caveats about large-scale assessment and survey data notwithstanding – we can celebrate the hard work of teachers that is producing effective teaching and learning in the form of high student attainment in science. Yet, we also need to be mindful that, while students may be performing well in national and international science assessments, they are not necessarily engaged or motivated to continue with the subject. This dilemma, between teaching for exam performance and teaching for engagement, is something that many teachers whom I and my colleagues have worked with have articulated to us over the years. As one teacher pithily put it, '*Being curious – at some point in key stage 4 [ages 14–16] you have to kill it*' (Archer *et al.*, 2017).

So how can we best deliver on ASE's important fourth pledge, to support equity and inclusion in science so that all young people have access to excellent science education?

Our ASPIRES longitudinal study offers some useful insights (Archer *et al.*, 2023a). This mixed-methods project tracked a cohort of young people from age 10 to age 22. Through large-scale surveys (capturing the views of over 47 000 young people) and over 700 in-depth interviews with young people and their parents/carers over 11 years, we built a detailed understanding of the factors that shape young people's trajectories into or away from STEM

(science, technology, engineering and mathematics). As might be expected, given the historic intractability of inequalities in STEM participation (and the proclivity of social scientific research), the issue is complex and involves multiple interplaying factors. However, in a nutshell, our findings reveal how the likelihood of a young person aspiring to and pursuing STEM at A-level (post 16) and degree level is shaped by the interrelation of three factors:

- **Identity:** The extent to which a young person feels that their identity aligns with science and feels recognised by others in this way.
- **Capital:** The science-related knowledge, attitudes, behaviours and social contacts that a young person possesses.
- **Field:** The extent to which science cultures and settings, such as school science, support or hinder a young person's progression.

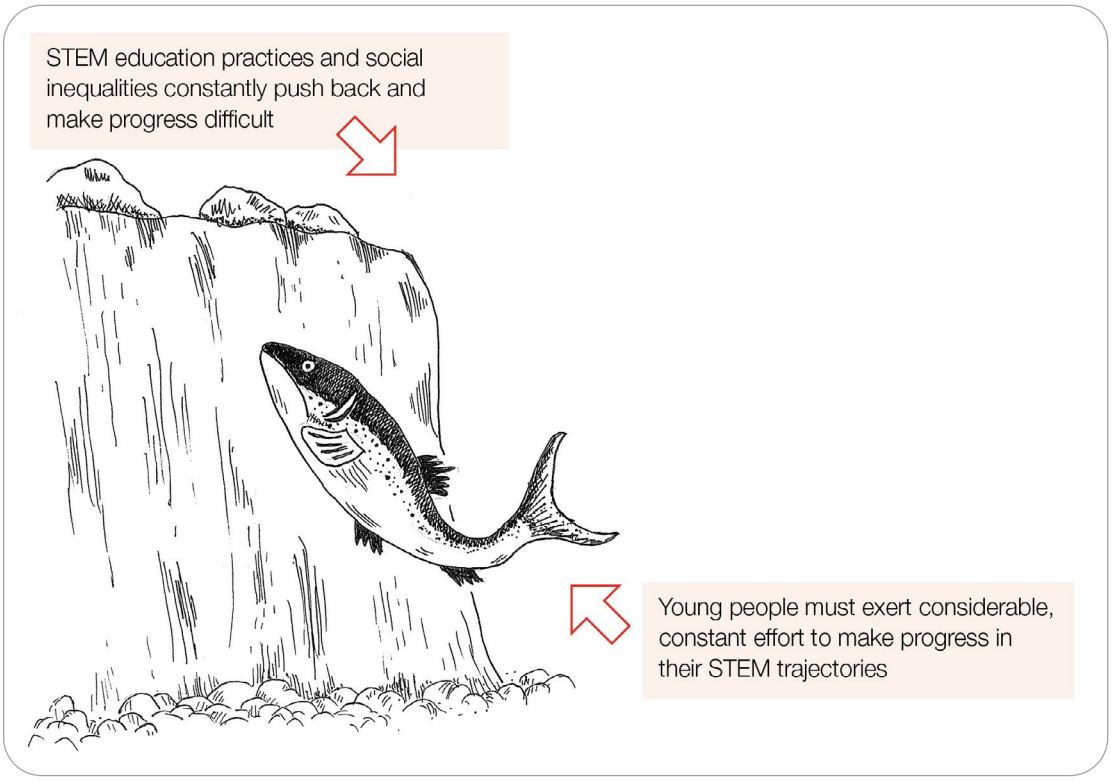
Statistically, we found a significant relationship between taking STEM (at A-level and degree level) and levels of STEM identity and STEM capital. That is, when a young person felt a sense of identification and connection with a given STEM discipline and when they had resources and capital relating to that area, they were more likely to pursue the subject at higher levels. Conversely, when a young person did not feel that their identity 'fitted' with a STEM field and did not have much capital in relation to it, they were much less likely to continue, even if they attained highly and were really interested in the subject. This is exemplified by students such as Kate, who loved physics but felt it would be 'too hard' for her at university, despite achieving the top grade in her physics A-level. We also found that having a lot of 'science capital' was not only associated with taking STEM at A-level and degree level but was also significantly related to a range of wider positive outcomes at age 22, including active citizenship, high job satisfaction, good health and feeling positive and well-prepared for the future (Ashford, DeWitt and Archer, 2024).

Of course, and as we all know, schools and teachers made a big difference to students' outcomes and progression. Students recounted how experiences of good-quality, supportive teaching helped them to engage and continue with STEM subjects, whereas they described how poor experiences led to them choosing otherwise, even when they were interested in and good at a subject. Teachers who went 'above and beyond', providing personalised support over time to a young person, played a particularly key role in supporting the social mobility of working-class young people in the study (Archer *et al*. 2023b).

However, too often young people also recounted examples of being dissuaded and blocked from continuing with science in a range of ways. These included the negative effect of the 'streaming' of students into 'double' and 'triple' science pathways, the 'chilly climate' of some subject classrooms for students from under-represented backgrounds and some teachers' stereotypical comments (e.g. '*my teacher told me you need a boy brain to study maths and physics*'). In universities, women STEM students were also significantly more likely than those taking non-STEM subjects to experience peer sexism in their courses. We found that policy conditions, such as grade severity in A-level physics and chemistry (when these subjects are marked more harshly than others), encouraged schools to limit access to advanced STEM pathways (Coe *et al*., 2008; Ofqual, 2015; Thomson, 2022). In sum, the system often made it difficult for young people to continue in STEM, and we found that those who did pursue STEM pathways tended to benefit from an extensive 'wrap around' of support (for their identity and capital) that extended over time and across the contexts of home, school and out-of-school settings.

I find it helpful to think about young people's STEM trajectories by using the analogy of a salmon swimming upstream (Figure 1). The salmon (the young person) has to exert relentless, considerable effort to navigate the fast-flowing river and waterfalls (representing the STEM educational field) that constantly push back against their progress. This raises an interesting policy question: should our initiatives focus only on trying to make the salmon stronger (as per many current interventions and policies) or should we also try to change the waterway,

to smooth the journey for all? (Archer *et al.*, 2023b). We believe that the latter offers a more effective and sustainable way forward, and many of our recommendations are based on the idea that increasing and diversifying participation in STEM might be best achieved by changing 'the field' (addressing the factors that sustain inequitable patterns of STEM participation), rather than solely trying to change or support individual young people.



▲ **Figure 1** The salmon analogy (Archer *et al.*, 2023a: 39)

So how might we do this? How can teachers and schools support young people's STEM identity and capital? ASE's third pledge (for increased funding to support teachers' training and professional development) is timely and useful in this respect. Alongside content-based CPD, our work also underlines the value and need for equity-based forms of training. Over the years we have been privileged to work extensively with primary and secondary teachers to translate our research findings into practical principles, tools and approaches for educators. All of this work has underlined the critical importance of providing teachers with time and support, through high-quality, extended professional development, to engage in critical professional reflection. This principle, of critical reflection, underpins all the resources produced, such as the Equity Compass and the primary and secondary versions of the Science Capital Teaching Approach, which are all free to access (see *Useful links*). They help teachers to embed equity in their practice and link science content to students' lives, interests and identities. As the teachers we have worked with explain, even small 'tweaks' to practice can make a big difference. As one teacher explained '*I was surprised what a difference could be made by such a small thing. You could see the pleasure on the children's faces, that everyone was interested in their knowledge and views*'. But as is also widely recognised, resources on their own may be useful, but professional development can be critical for embedding changes to practice and to achieving sustained change at scale.

Organisations like ASE are vital for supporting teachers and advocating for the importance of more time, resource and support to create 'brave spaces' where teachers can critically reflect, experiment, take risks and continually evolve their practice. Equity work is not a quick 'tick box' exercise, it is a difficult journey. It is not just a case of implementing 'what works' but working collectively to create the conditions in which all teachers and students can learn and thrive together in science.

USEFUL LINKS

Equity Compass: https://yestem.org/wp-content/uploads/2022/03/Equity-Compass-for-teachers.pdf

Science Capital Teaching Approach, primary: www.ucl.ac.uk/ioe/departments-and-centres/education-practice-and-society/research/stem-participation-social-justice-research/primary-science-capital-project

Science Capital Teaching Approach, secondary: www.ucl.ac.uk/ioe/departments-and-centres/education-practice-and-society/research/stem-participation-social-justice-research/science-capital-teaching-approach

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