



Increasing diversity in STEM: Principles for effective interventions.

Purpose of this document

NUSTEM at Northumbria University is working to increase diversity within STEM by showcasing STEM careers to children and young people, along with their teachers and families.

This document sets out **NUSTEM's** core argument to serve as guidance for shaping interventions aimed at increasing the number of young people entering a STEM career.

Objectives & Context

Many organisations are, individually and collectively, keen to see an increase in the STEM workforce. This will be achieved through a combination of improving staff retention, return-to-work rates, and inward recruitment; and by drawing more young people into the sector. This document considers the latter component.

The **step-change we wish to see in children's and young people's** progression to STEM careers is likely to draw on groups currently under-represented in these careers. In many organisations these groups are: girls, young people from areas of higher levels of socio-economic deprivation, and from black and minority ethnic groups¹.

Starting points

Previous research shows us that:

- **People like science and engineering...**

This is sometimes a surprise, but the evidence² suggests public perception is that the STEM sector is useful, beneficial, and even exciting. This holds for adults and children. Most children leave primary education citing science as one of their favourite subjects. Even in secondary school NUSTEM have found that the majority of young people say that they learn interesting things in science.

- **...but most think that STEM work isn't done by 'people like me'.**

The challenge isn't so much one of interest, but of aspiration and self-identity³. Science doesn't have to be made 'fun', careers involving science (STEM) need to feel achievable.

- **Children's key influencers are their teachers and their parents/carers⁴.**

We need to shift attitudes amongst children's support structures; attracting and maintaining the interest of children themselves is necessary but not sufficient.

Components of 'good' interventions

Interventions which are likely to have impact in the long-term will prominently feature one or several of these aspects:

- Plan your evaluation first

Without evaluation, we won't know if our intervention has had any effect. Even before we start to plan an activity, we need to identify what change we are hoping to achieve. That way we can think realistically about *how* the proposed intervention will actually bring about the intended change. We should monitor interventions and deliveries for quality assurance purposes, but we should also aim to construct interventions so they dovetail with ongoing research and evaluation efforts. To support this NUSTEM has developed a Theory of Change⁵ which outlines possible pathways for change.

- Start young

Young people's key decision points are around age 13–14, when they choose their GCSE options, and two years later when they choose what to do next. But the landscape and context for those decisions starts *much* younger, with many children making career-*limiting* choices before they leave primary school⁶. Accordingly, interventions with primary-aged audiences are fundamental to effecting change. For example, NUSTEM works with children (and their families) from aged 2 and upwards.

- Focus on under-represented groups

Within different industries, some groups are more under-represented than others. In STEM sectors, this can include females⁷ and those from lower socio-economic backgrounds. Children and young people from these groups are less likely to see careers in TPSE as being **for 'people like me'**.

- Work with influencers

Children's decisions are made in concert with their teachers, and with their parents and carers. Working with these groups should be prioritised. Showcase and reinforce good practice; make interventions easy for teachers to access and adopt; welcome family groups to normalise household discussions around STEM subjects. This might mean that interventions need to take place outside the school (and working) day: after-school or in holidays.

- **Reveal opportunities; introduce real people**
Children from groups under-represented in **the STEM sector typically don't know any STEM workers**³ – a vicious circle. Introducing role-models is a key component of addressing this. They might be workshop leaders, hosts, or narrative examples, and present in person or via video or stills. Every interaction matters, since each is an invitation for a child to recognise a possible STEM identify for their future self.
Each interaction builds understanding of the range of opportunities available across the region, the types of people filling those roles, and the routes and connections between where the child is now and a STEM-sector destination.
- **Extend opportunities at primary; support choices at secondary**
Primary teachers are often eager for enrichment activities in science, DT and computing, and parents and carers are typically keen to support their children, but may not be sure how to do so. At secondary, young people need support and reassurance that a STEM career path is **'normal,' achievable, and desirable**, particularly through ages 12–15 where peer acceptance becomes more important to young people. Peer and family pressure, and sometimes outdated school/teacher attitudes, can work against **a young person's** expressed interest. Yet as external agents, we typically know little about the individual. We should aim to be critical friends: to support and encourage, but not to campaign or steer.
- **Look for partnership and legacy; don't try to do it all yourself**
What we see as specific interventions, our participants see as just another part of their week. For the most effective impact, our interventions should aim to affect teaching practice, **family behaviour, or children's perceptions over the long term**. Where possible we should work with other organisations to provide a coherent message or activity offer.
- **Details matter**
Obvious examples might be the unthinking use of gendered language (**'Listen up, guys!'**), or presentation of case studies drawn from a single demographic. But we also need to be aware that the differences within our target audience are typically greater than they are between that audience **and another**. That is, phrases like **'Girls think that...'** or **'All engineers are...'** should ring alarm bells, and be avoided.
- **Quality matters**
Both the quality of the materials and interventions, and the quality of the delivery is important. Intervention facilitators should have appropriate training in communication skills for different audiences, and an understanding of unconscious bias in general, and awareness of their own biases which might affect delivery.

- Honesty about our limitations; target our resources

No single intervention will solve all problems, or even appeal to all individuals. At best, we **extend an opportunity and hope individuals seize it. If they don't, we try again: we try different routes, we come back later, we work in groups or individually, we reward excellence or celebrate participation... all interventions have their place, but the range of opportunities and approaches matters.** Not everyone likes competition, so we also target experiences for wonder and delight. Not everyone likes whizz-bang-wow, so we develop situations where participants can become absorbed in an activity.

We must also be aware that some schools and families are particularly good at putting opportunities in front of their children. No single child is more or less deserving than any other, but the extra effort required to reach the **'hard to reach'** is on us, not them.

Finally:

No single intervention is likely to encompass all of these principles: individual projects or engagements will not solve the problems of involvement and diversity within STEM on their own, but we increase our chances of reaching the outcomes we desire by ensuring that all our interventions contribute towards a coherent strategy.

NUSTEM act as STEM engagement consultants and can support organisations to design and develop their public engagement strategies and materials. If you would be interested in talking to us about this then please contact us at nustem@northumbria.ac.uk

For more information about NUSTEM see our website: nustem.uk

¹ Engineering UK 2017 The State of Engineering

² Wellcome Trust (2016), *Wellcome Trust Monitor: Wave 3 Tracking public views on science and biomedical research*.

³ ASPIRES (2013) *Young people's science and career aspirations age 10 - 14*, and also MacDonald, A., (2014) *Not for People Like Me*, and subsequent 'People like me' project run by Women in Science and Engineering: <https://www.wisecampaign.org.uk/people-like-me>

⁴ Wellcome Trust (2013), *Wellcome Trust Monitor: Wave 2 Tracking public views on science, biomedical research and science education*.

⁵ Davenport et al. (2020) <https://link.springer.com/article/10.1007/s11165-019-09909-6>

⁶ Gottfredson, L. (1981) 'Circumscription and Compromise: A developmental theory of occupational aspirations', *Journal of Counselling Psychology Monograph*, 28, 6, 545 - 579

⁷ Although at A-level and degree level biology and chemistry do not have a shortage of female participants, the numbers decrease precipitously as level of seniority increases.