nustem

Increasing diversity in STEM: Principles for effective interventions.

Purpose of this document

There are as many ways to approach STEM engagement as there are objectives we have in doing it. NUSTEM at Northumbria University is working to increase diversity within STEM by showcasing STEM careers to children and young people, along with their key influencers.

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 TPSE (Technology, Physical Sciences and Engineering) 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.

Implicit, if not always explicit, is the understanding that the step-change we wish to see in children's and young people's progression to STEM careers is likely to draw on currently under-represented segments. In the technology, physical science and engineering segment, that means: girls, young people from areas of higher levels of socio-economic deprivation, and from black and minority ethnic groups[1].

[1] Engineering UK 2017 The State of Engineering

Northumbria University NEWCASTLE

Starting points

- **People like science and engineering…**
  This is sometimes a surprise, but the evidence[2] 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-identity[3]. 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/carers[4].**
  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:

- **Evaluate, assess, monitor, research**
  Before planning to deliver an intervention, it is important to identify our intention and aims for that activity. 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. We need evidence and reassurance that the subtle, long-term, capability-building approach outlined in this document is effective.
- **Start young**
  Although 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 school[5]. Accordingly, interventions with primary-aged audiences are fundamental to effecting change. For example, NUSTEM works with children (and their family) from aged 3 and upwards.

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

- **Focus on under-represented groups**
  Within different industries, some groups are more under-represented that others. In STEM sectors, this can include females[6] 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'. Although there is not clear evidence of the efficacy of different interventions targeting different groups, the Institute of Physics has produced a guide for Inclusive Science Teaching[7]. These 'top tips' are applicable to informal STEM engagements as well.
- **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[8] – 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**
  At primary, STEM subjects are simply 'science' and 'maths', 'DT' and more recently 'Computing'. Primary teachers are often eager for enrichment activities, and parents and carers – particularly in under-served areas – are typically keen to support their children.
  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

[6] 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.
[7] https://education.gov.scot/improvement/documents/sci38-tips-poster.pdf
[8] ASPIRES (2013)

children's perceptions over the long term. These objectives may be achieved through, for example, showcasing or training in good teaching practice; offering easily-accessible materials and activities for continuation work at school or home; pointing towards related or extension materials or opportunities; or through providing opportunities which might form key lifetime memories.

- **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, nor 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.

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