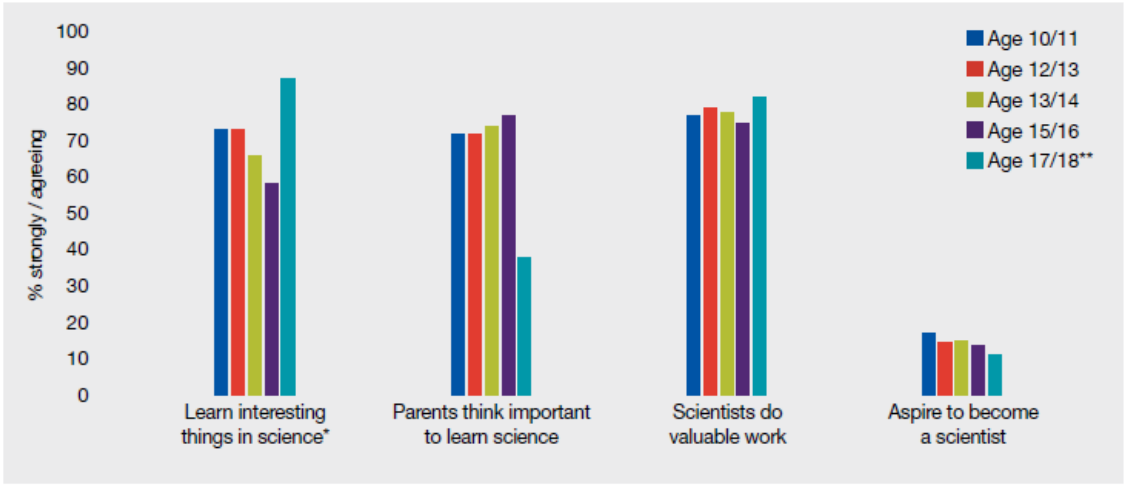
STEM: improving gender balance, equity and equality

Only 5.65% of Engineering and Energy related Modern Apprenticeships in Scotland were filled by women in 2018/19. (SDS)

At SCQF level 6, only 27.5% of Physics candidates and 16.6% of Computing Science candidates were female in 2019. (SQA)

"Young people from the most deprived areas (SIMD 1) were less likely than those in the least deprived areas (SIMD 5) to report that they had chosen to study or were intending to study a STEM subject (57% versus 71%)."[1]

There are long-standing patterns associated with gender, race and class in who does and does not choose to pursue STEM pathways. Diversifying participation requires us to understand the underlying drivers of those patterns, and to plan appropriate, sustained and nuanced responses.



A high proportion of young people feel they learn interesting things in science, feel their parents think it is important to learn science and agree that scientists do valuable work. However, a persistently low proportion see themselves becoming a scientist. (Graph from Aspires 2)

Crucially, as the graph above suggests, the issue is not a lack of interest in STEM. Nor is there an issue with the perception of the value of STEM to society.

There are, however, issues with perceptions of who 'does' STEM, who perceives themselves as 'right' and 'good enough' for STEM, and who feels encouraged into STEM.

This paper summarises some of the key factors underlying the patterns of STEM participation in Scotland, and sign-posts to possible approaches to address the root causes.

1. STEM is perceived to be 'masculine' and 'brainy'

"The pervasive association of science with 'cleverness' – an association that made it difficult for many students to continue with the subject." [2]

There is a persistent association of science & STEM with 'cleverness' and 'masculinity'. This makes many young people feel that STEM is 'not for me'.

We will examine below how the interplay of race, class and gender impact who is likely to feel they are 'brainy'. Here, however, we point to the work to be done to challenge the perceptions of who does science, the notions of STEM as being hard and requiring a 'science brain'.

2. Girls tend to have less belief in their own abilities in maths and science, even high attaining girls

Girls, in general, have lower levels of self-efficacy than boys in both mathematics and science. Girls are less like to feel 'clever'. The difference is much wider in mathematics than in science. The gender gap in feelings of confidence depends greatly on the type of problem and the context of the problem. [3]

"Some studies have found that girls rate their own ability as lower than that of boys as early as the first year of primary school – even when their actual performance does not differ from that of boys." [3]

The Young People in Scotland survey found that of the learners not choosing or not intending to study STEM, girls were significantly more likely than boys (40% vs 17%) to report that they didn't think they were very good at STEM subjects. [1]

This issue will not be countered with simplistic measures.

3. Learners will be sensitive to practitioner expectations

Practitioners may unwittingly have differing expectations of boys and girls. These expectations can be communicated through micro-messages such as body language and choice of words.

"Consistently … from age 10-18, boys were significantly more likely than girls to report that their teacher expected them to do well in science, and to feel that their teacher cared whether they understood science." [2]

"Despite the encouragement individual students receive from their teachers being a key factor associated with aspirations to continue with physics, girls were statistically significantly less likely to receive such encouragement." [6]

Unconscious bias may also impact practitioner expectations of individuals based on other characteristics, including SIMD and ethnicity.

"Girls, working-class and minority ethnic students found it hard to be recognised as 'clever', and hence as 'scientists', regardless of their attainment. This was particularly amplified in the case of physics." [2]

4. Instilling confidence to 'think like a scientist'

Research strongly suggests that there is no inherent difference between girls and boys which should limit their capabilities. PISA reveals that girls tend to do better when they are required to work on mathematical or scientific problems that are more similar to those that are routinely encountered in school. However, when required to "think like scientists", girls underperform considerably compared to boys.

"This gender difference in the ability to think like a scientist may be related to students' self-confidence. When students are more self-confident, they give themselves the freedom to fail, to engage in the trial-and-error processes that are fundamental to acquiring knowledge in mathematics and science." [3]

5. Literacy

Boys tend to underperform in literacy areas compared with girls. [4] This is a gender issue in itself. Further, however, this underperformance in literacy of some boys can impact how some girls perceive their own abilities, including the perception that they are 'not good' at numeracy based subjects. One way to tackle this is to focus on raising boys' attainment in literacy.

"Because girls tend to perform so well in reading, they may, unconsciously, believe that they are underperforming in other subjects." [3]

6. Perceived irrelevance of STEM

Many young people do not see the relevance of STEM subjects to their lives, and this lack of perceived relevance can lead to a decline in interest.

There seems to be a need to "humanise" science: to make much more apparent the link between STEM, values, and personal and societal interests. [5]

Approaches

The problem, as outlined above, is multi-faceted and deep-seated. Many of the issues relate to an individual's sense of self – who am I and what am I good at? One-off activities or interventions tend not address these underlying issues and therefore tend not to have a lasting impact. If used, they need to be part of a wider, long-term strategy. Role models can have a positive impact, but usually only where there is an ongoing relationship.

It might be helpful to consider the following:

- What examples are used of people working in STEM both historical and contemporary? What language is used to describe science/scientists and what imagery is used to illustrate STEM?
- Which contexts are used and have gender-stereotypical contexts been avoided?
- What approaches could be taken to explicitly develop learners' skills and confidence in applying science knowledge to a range of contexts?
- What approaches could be taken to explicitly develop skills of 'thinking like a scientist' in all learners from an early age?
- How are high expectations communicated to all learners and their families?
- How might learners' perceptions of who can do which jobs be challenged? Note that if asked directly, young people will generally state explicitly that all jobs can be done by anyone. A more nuanced approach is needed to surface and challenge implicitly held beliefs.
- How might gender (and other) stereotypes be explored and challenged in an ongoing and sustained way? Note that although this paper has focused on the impacts on girls in relation to STEM specifically, work on stereotypes would ideally consider the impacts of gendered thinking on all learners.
- What approaches could be taken to allow young people to meaningfully experience something they might otherwise self-select out of? At every stage, many children and young people self-select out of certain activities based on their observations of what is appropriate. Being 'open to everyone' will not, in itself, widen participation.
- What steps might be taken to build STEM capital in communities?
- How might practitioner knowledge of post-school opportunities be extended?

This paper has focused predominantly on issues related to gender and poverty. It might also be appropriate to consider how your work will address other aspects of inequity such as rurality, and promote equality in relation to the other protected characteristics such as disability, race, and for people who are care experienced.

IGBE Resources & Links

The Improving Gender Balance and Equalities (IGBE) programme at Education Scotland has developed resources to support practitioners.

Contact us at IGBE@educationscotland.gov.scot

Follow us on twitter @EdScotIGBE

References

1. STEM and language choices in school: Young People in Scotland Survey 2017

2. ASPIRES Report: Young people's science and career aspirations, age 10-19 (2020)

3. The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence, PISA OECD Publishing (2015)

4. The evolution of gender gaps in numeracy and literacy between childhood and adulthood OECD Education Working Papers No. 184

5. The Relevance Of Science Education (ROSE) project: An overview and key findings (2010)

6. UPMAP (Understanding Participation Rates in post-16 Mathematics And Physics) (2013)