

Tapping all our Talents 2018



A progress review
of **women** in science,
technology, engineering
and mathematics
in Scotland

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Tapping all our Talents

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Foreword

Six years ago, as Chief Scientific Advisor within the Scottish Government, I was pleased to engage with the Royal Society of Edinburgh on its first report on women in STEM, *Tapping all our Talents*.

I was concerned about the wasted talent presented by the leaky pipeline which saw almost three-quarters of female graduates lost from STEM and women significantly under-represented in top positions across business, public service and academia.

On becoming President of RSE, I was therefore delighted to learn that the report was being revisited to see what change had occurred over the intervening years and what more remains to be done.

I want girls and women to know STEM is for them both as a subject of study and as a career choice. Since I began my career in science much has changed, yet we still have some way to go to create a positive working environment for all women.

It is imperative that we do so; not only is it important that as a nation we harness the talents of all our citizens but there is now a clear body of evidence that diversity in the workforce not only allows individuals to fulfil their potential, but that more diverse teams are more effective.

While this report represents a significant contribution to the debate on women in STEM we know it is not the end point and we stand ready, as Scotland's National Academy, to support a continuing conversation and further work with education providers, business, government and wider society on how we can truly tap into the talents of all our workforce to the benefit of Scotland and its people.



Professor Dame Anne Glover
RSE President



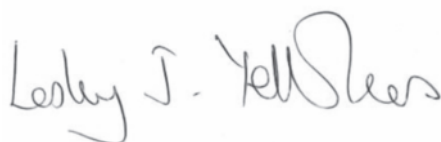
Preface

It's six years since *Tapping All Our Talents* (TAOT) was released by the RSE in 2012. Much has changed in that time but has the lot of women in Science, Technology, Engineering and Maths (STEM)? Has the infamous 'leaky pipeline' – the graph which shows the lack of women making it to leadership positions in academia – been fixed? Are more than 27% of female graduates entering a STEM-related job on graduation? Are women in STEM in a better position, a worse position or in just the same position as previously? What more needs to be done to enable women to play their full part in shaping our future – helping to solve today's key Challenges using STEM-based skills to build a better and more economically vibrant Scotland?

These were some of the questions that motivated the RSE to look at current data and engage with interested groups and individuals to produce TAOT2018. The Young Academy of the RSE immediately offered their help on learning of the intended report and their enthusiasm, commitment and skills are gratefully acknowledged. My thanks also go to the Working Group, everyone who contributed and particularly to Susan Lennox, who led on the drafting of this report.

As the Working Group started this study we debated what the scope of TAOT2018 should be. We decided to reconsider topics from the original report and to complete the 'pipeline' to include pre-undergraduate years. We made a positive decision to limit ourselves to STEM subjects because much still remains to be accomplished here.

Many years ago, when I first became aware and interested in the issues surrounding a lack of women in STEM, I set myself the target of trying to make STEM a more inclusive world for the women of tomorrow. Progress has been too slow for my daughter's generation but I am hopeful for my granddaughter's. I hope the TAOT movement will make a difference for her and for all Women in STEM.



Professor Lesley Yellowlees
Chair of RSE / YAS Women in STEM working group



Tapping All Our Talents 2018: Executive Summary

It is well recognised that Scotland must nurture, develop and value its STEM (Science, Technology, Engineering and Mathematics) skills base, if it is to rise to the challenges that are increasingly shaping its economy and its society. An innovative economy and STEM-literate society are crucial to ensuring that Scotland can respond to – and, indeed, take full advantage of – global disruption driven by digital technologies, the changing climate and an ageing population.

Diverse teams can flourish through the creativity that results from bringing together different ideas, views and experiences, from greater constructive debate and from broader understanding of clients' needs. Research links greater diversity in an organisation's workplace with greater likelihood of above-average profitability.

Yet, at a time when both the Scottish Government and industry identify STEM skills gaps as restricting progress towards national ambitions and economic performance, entrenched gender stereotypes continue to limit the potential of girls and young women to fully develop their interest and abilities in STEM subjects. *Tapping All Our Talents 2012* found that, even where young women overcame barriers to studying STEM and graduated with STEM degrees, only 27% remained in the STEM sector; around half the equivalent proportion of their male counterparts.

Improving gender equality in STEM is both a social justice imperative and economic necessity. *Tapping All Our Talents 2012* set out the foundations of a national strategy towards gender equality in STEM workplaces in Scotland. It was a call to action, articulating the case for urgent focus on the issue, outlining the barriers women faced in STEM, and identifying steps to tackle under-representation. Six years on, the Royal Society of Edinburgh (RSE) and Young Academy of Scotland were eager to explore what progress, if any, has been made.

Through a public consultation, a series of roundtable discussions, and a review of the literature and data available, the *Tapping All Our Talents Review 2018* considers what has – and has not – changed for women working in STEM in Scotland today. Recognising the need for an holistic, coherent and sustained approach to engaging girls and young women in STEM, the RSE expanded the remit of the Review Group to consider female under-representation in STEM education and training, as well as in STEM workplaces.

The Review Group was heartened to find that, by some measures, marked progress has been made towards redressing gender imbalances in STEM:

- The proportion of female STEM graduates in the UK working in the sector has increased from 27% in 2012 to 30% in 2017.¹
- In industry, UK-level figures indicate that the proportion of women in core STEM professions rose from 13% to 23% in the same period.
- At the current rate of progress, STEM FTSE 100 companies are expected to meet a voluntary target of 33% of women on boards by 2020.
- In academia, the number of Scottish STEM (includes medicine) departments holding Athena SWAN awards, which recognise efforts to enhance gender equality, reached 73 by Spring 2017, up from a total of five awards in 2012.
- The proportion of female professors in Mathematics trebled from 3% (2012) to 10% (2017) and in Chemistry doubled from 5% to 10%.

¹ For consistency and readability, decimals in the figures presented in the report have been rounded up or down to the nearest whole number

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Such progress, however, is not universal:

- In education, the proportion of young women studying for Computing-related² qualifications at SCQF levels 3 – 5³ has fallen from 32% in 2012 to 18% in 2018.
- In most STEM subjects across colleges and universities, the proportion of female students has seen, at best, incremental improvement (e.g., from 11% in 2012 to 13% in 2016 in undergraduate engineering) and, at worst, further decline (e.g., from 54% in 2012 to 43% in 2017 in college-level IT frameworks).
- The number of female executives in FTSE 100 companies remains stubbornly below 10%.
- The overall gender pay gap in Scotland has seen little movement, standing at 18% in 2012 and 16% in 2017.

What has become increasingly clear in the years since the publication of *Tapping All Our Talents 2012*, is that gender equality in STEM can only be achieved through a fundamental shift in societal perceptions of gender ‘norms’ more generally. This is a significant and complex challenge: stereotypes are introduced at birth and consistently reinforced by families, carers, peers, media, social media, educators and employers. But it is a challenge that must urgently be tackled if Scotland is to eradicate the harmful impact of such stereotypes on the wellbeing of all its young people and enable them to reach their full potential.

It is within this societal context that the *Tapping All Our Talents Review 2018* considers what must be done to achieve a step change in progress towards gender equality in STEM. Every individual and institution involved in educating children and young people in Scotland, and in shaping STEM workplace cultures and practices, has a role to play in breaking down the barriers that girls and women face. The report considers each stage of education and training, and both industry and academic workplaces, setting out the key findings on persistent barriers and possible next steps for each one.

Many of the challenges that girls and women face to engaging in STEM manifest at a very early stage and persist throughout education, training and work. Unconscious – and sometimes conscious – biases shape the advice and guidance given to girls and young women by their many influencers, from parents and teachers to peers and media. Misperceptions of STEM and STEM careers, the stereotypical view of the brainy scientist in a white lab coat, act as a deterrent to young women who frequently seek creativity and positive societal impact in their career choices. This is compounded by low teacher confidence in STEM, particularly within primary schools and often out-of-date or limited understanding of STEM industries.

In the workplace, biases persist in the attitudes and actions of management and colleagues and in processes, including recruitment and promotion. With STEM industries often dominated by men, women can face a challenging working environment, have fewer role models, less peer support and more difficulty in building or accessing networks. These barriers compound the difficulties that many women, in all sectors, face to remaining in the workforce when they are also expected to take on a greater share of caring responsibilities. The paucity of high-quality flexible and part-time roles, the impact of career breaks on long-term career prospects, expensive and inflexible childcare and the persistent gender pay gap are all obstacles to gender equality in the workplace.

² Includes Computing, Computing Studies, Computing Science and Information Systems

³ SCQF levels 3 – 5 comprises those courses that can broadly be considered equivalent level to Standard Grade, including the National 3, 4 and 5 courses and the Intermediate courses

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But there emerges a number of themes that will underpin the success – or otherwise – of the drive towards gender equality in STEM across every stage and every sector. It is under these themes that the *Tapping All Our Talents Review 2018* makes its **key recommendations**. Recognising that there is no single path through which the complex and sizable issue of gender equality can be addressed, these are high-level recommendations that we hope will stimulate a wide national conversation within and across sectors about the specific actions required to address continuing gender inequality in STEM and across society.

Underpinning activity at all levels and across all sectors and pathways are four themes:

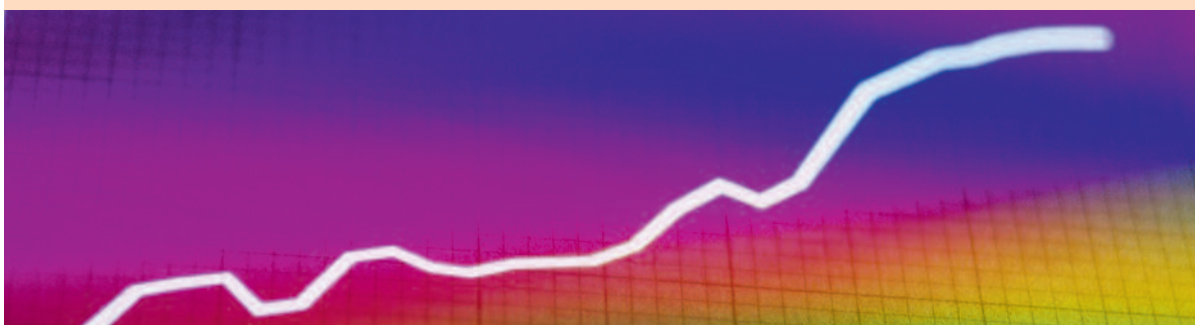
- the need for **leadership** to drive culture change;
- the need for better **data** that allow real understanding and tracking of the extent of gender inequality in STEM, barriers to progress and appropriate solutions;
- a focus on **behaviour change** that recognises the benefits of gender equality for everyone and that renders bias and discrimination unacceptable; and
- strong, sustained partnerships between educators and industry to deliver **education and training** that inspires all young people to engage in STEM.

Leadership

- 1 UK and Scottish Governments must wield political leadership, influence and resources to embed gender equality in society and to drive a multi-sector, collaborative approach to tackling gender stereotypes at the societal level.
- 2 Public bodies, educators, employers and industry leaders must deliver culture change that promotes equality. This requires strong, visible leadership from the top and buy-in at every level; e.g., through widespread gender competence training and design of performance metrics. It also calls for developing and normalising uptake of progressive policies and practices; and embedding equality and diversity into all existing activity.
- 3 UK and Scottish Governments must lead a step change in societal views on parental roles, using legislation, policies and public funding to drive acceptance that childcare is the equal responsibility of both parents. Childcare needs to be an economic and labour market priority. It requires investment and intelligent design to deliver an holistic, flexible, affordable system that reflects the reality of workplace demands, and allows women to return to work should they wish to do so.

Data and accountability

- 4 The Scottish Government, in designing the methodology of its proposed Gender Index Report for Scotland, must develop and invest in publishing STEM-specific data which, while respecting anonymity, are disaggregated as far as possible to allow for understanding of intersectionality, sectoral differences and regional variations. Transparent, accessible disaggregated data are crucial to providing a more accurate picture of the STEM sectors than current labour market data have the capacity to provide.
- 5 The Scottish Government must lead improved understanding of what works to progress gender equality in STEM. This may be through the development of an 'Intervention Tool' that maps interventions by current strength of evidence, impact and cost-effectiveness. There should be a requirement that all publicly-funded trial gender equality initiatives have strong monitoring and evaluation frameworks; and that those being rolled out further are clearly evidence-based.
- 6 This has implications for the funding of bodies and initiatives, since short-term funding precludes long-term evaluation. The Scottish Government must ensure that public funding to advance gender equality in STEM is focused on delivering sustainable and scalable impact. This includes committing to longer-term funding for third sector organisations that deliver cross-sector support on gender equality.
- 7 Public and third sector bodies that support organisations to progress gender equality must consider how to assist them to build the capacity and skills required to undertake research to identify and analyse internal barriers, to develop appropriate interventions, and to effectively monitor and evaluate impact.
- 8 The UK and Scottish Governments and public bodies that require organisations to report on gender equality measures must do so in a way that drives action to address inequalities. It is not sufficient to expect organisations to comply with equalities requirements; public bodies must rigorously monitor performance on equality and hold organisations to account accordingly.



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Behaviour

- 9 The Scottish Government must target the key influencers on children and young people to challenge behaviours and attitudes that entrench gender stereotypes in the next generation. The RSE welcomes the Scottish Government's commitment to action on this issue in its Programme for Government 2018–19 and urges it to prioritise activities that will have the greatest impact, with renewed focus on engaging families and carers from the early years stage.
- 10 Education institutions and employers must have a zero-tolerance stance on unacceptable misogynistic behaviour and sexual harassment in study and work places; while developing cultures that minimise unconscious bias and gender stereotyping through appropriate training for staff and inclusive/progressive organisational policies, practices and standards. Making available high-quality part-time and flexible roles as standard was highlighted to this review as the development that would have the greatest impact on gender equality in the workplace.
- 11 More employers must move from rhetoric to decisive action on gender equality by participating in evidenced, legal and proportionate positive action⁴ measures, including the introduction of placements solely for undergraduate women. In doing so, they could draw on examples from education, including City of Glasgow College's pioneering women-only courses in engineering and construction, which have resulted in a significant increase in female enrolments in sectors where women are under-represented. Employers should look to raise awareness of the need for and impact of positive action measures and work to create a culture where "redressing the balance" of under-representation is not only accepted but celebrated and participated in by all genders within a company.

Education and training

- 12 The Scottish Government, local authorities and education agencies, working with providers of teacher education and professional learning, must ensure that all education settings across Scotland are gender aware and competent. This requires empowering teachers to recognise and remove gender stereotypes from classrooms and developing a gender-inclusive curriculum.
- 13 The Scottish Government, education agencies, early years providers, schools, colleges, universities and employers need to work in strong, coherent partnerships to deliver high-quality, inspiring and inclusive STEM learning. This must support positive, up-to-date understanding of STEM pathways and careers amongst young people and their families. The development of new regional STEM hubs and the Regional Improvement Collaboratives, coupled with the Developing the Young Workforce agenda, provide an excellent and timely opportunity to embed activity on gender equality and STEM within and across the education and employment sectors.
- 14 Recognising that single intervention does not work, industry should look to create sustainable and strategic partnerships on gender equality with schools, colleges and universities which provide both access to knowledge for teachers and pupils at the school level, and "theory into practice" opportunities for under-represented students through placements, work experiences or engagement events.

⁴ Positive action measures are proportionate measures that specifically target groups that can be reasonably considered disadvantaged in order to reduce under-representation and meet particular needs.

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1 Introduction

1.1 The imperative

Scotland, 2012: the Scottish Government has identified a number of priority growth industries, from life sciences to energy to food and drink, all of which rely heavily on STEM occupations and innovation. Scottish employers and industry bodies report serious skills shortages across science, computing, engineering and manufacturing. Scottish Power warns of a deteriorating skills situation in the energy sector, with 80% of its engineers due to retire within 20 years.

Yet in the face of such skills shortage and unmet demand, some 73% of female STEM graduates leave the sector. An average of just 9% of STEM professors are women. In STEM FTSE 100 companies, only one CEO position is held by a woman and women account for just 11% of directorships.

Source: *Tapping All Our Talents 2012*, RSE

This was the context in which the Royal Society of Edinburgh (RSE) produced its 2012 report *Tapping All Our Talents – Women in STEM, a Strategy for Scotland*. The report set out a strategy for Scotland to ensure that female STEM graduates can fulfil their full potential, to the benefit of themselves and to the nation. STEM needs to be inclusive on the grounds of equal opportunities, social justice and gender equality; and STEM needs to be able to draw upon the widest possible talent pool to enable it to flourish, with attendant benefits to Scotland's economic and social wellbeing.

In Scotland 2018, the imperative has not changed. In a world increasingly shaped by rapid technological transformation, vibrant, innovative STEM industries are pivotal to a successful economy and a strong, sustainable society. Yet skills shortages continue to limit performance and are compounded by an ageing population, a dip in entrants to the workforce and Brexit uncertainty, particularly in relation to future access to and, retention of, European and international STEM talent. This reinforces the importance of ensuring that Scotland fully utilises the talent of its people.

Given this context, the RSE was keen to explore whether progress has been made towards equality for women in STEM in Scotland. Is Scotland now better placed to tap into the talents of all its workforce, enhancing the opportunities and outcomes for both its people and its economy?

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The RSE, together with the Young Academy of Scotland, established a Tapping All Our Talents Review 2018 Working Group, with a remit to:

- 1 Consider what progress, if any, has been made on the recommendations of the 2012 report.**
- 2 Investigate current data to discern whether the arguments made six years ago remain valid.**
- 3 Consider the changing landscape in which issues of women's inequality are being tackled.**
- 4 Go further than the 2012 report to consider education and the journeys of girls and young women into STEM, taking a systematic approach to skills pathways from early years to retirement.**
- 5 Present an updated picture of women in STEM in Scotland and make recommendations on further action.**

The key conclusions and recommendations set out in this report reflect the findings from an open written consultation, a series of thematic roundtable discussions and a review of recent literature, policies and legislative developments that impact girls and women in STEM education and work. The Working Group sincerely thanks all those individuals and organisations who contributed their time and expertise to engaging with this review (see Appendix B for details).



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Tapping All Our Talents 2012: key recommendations⁵

1 To Scottish Government	a) A National Strategy for Scotland to tackle inequalities in the workplace for women in STEM. b) Tackle the gender pay gap in the public sector and through procurement, for example through the use of the Public Sector Equality Duty. c) Improve provision of high-quality, affordable, and accessible childcare.
2 To UK Government	a) Employment law to reflect the equal responsibilities of both parents. b) Appoint a Gender & STEM ministerial champion. c) Require head hunters to put forward equal numbers of men and women for top positions.
3 To business and industry	a) Establish an SME taskforce to consider how small businesses can tackle gender equality. b) Develop fast-track career paths. c) Introduce quality part-time employment. d) Promote culture change to enhance diversity. e) Develop progressive policies and practices.
4 To funders and investors	a) Require a universal minimum level of performance (Athena SWAN silver or equivalent). b) Ensure equality within own boards, panels etc.
5 To universities and research institutes	a) Attain Athena SWAN Silver Award: This typically involves commitment to equal pay, developing progressive policies, championing gender equality, and negating the impact of maternity/paternity leave on long-term career.
6 To Learned Bodies	a) Set standards and be models of good practice. b) Consider how to overcome historic male dominance in elections and awards processes.
7 To women and women's organisations	a) Be proactive and prepared to take risks in order to seize opportunities and fulfil potential. b) Raise organisational awareness of issues and how to effect positive change.

⁵ Full list of recommendations and details can be found in *Tapping All Our Talents: Women in STEM 2012*, available on the RSE website at www.rse.org.uk/inquiries



Definition of STEM

Tapping All Our Talents 2012 defined STEM as including Physical and Biological Sciences, Engineering and Technology, Mathematics and Computer Sciences. For continuity purposes, the 2018 Review of progress on *Tapping All Our Talents* has maintained this definition.

There are many variations on what is considered to constitute the STEM sector. For this reason, data sources cited in this report may draw upon different parameters. Broadly, however, definitions of STEM are in line with the approach taken in this Review, including that set out in the Scottish Government's STEM Education and Training Strategy.

As in 2012, issues of gender equality in relation to women in clinical medicine are not specifically addressed in this study, but recommendations will be of relevance to the position of women in academic medicine.

1.2 Has Scotland made progress on *Tapping All Our Talents*?

Six years on from *Tapping All Our Talents*, there has been a significant shift in awareness of the challenges facing women in the STEM workforce; and of gender equality issues more widely. Political leadership, gender pay gap reporting and the widespread reach of social media campaigns have created space in public discourse to raise awareness of gender inequality and to challenge accepted norms.

Awareness has, in many instances, come hand-in-hand with action. Coupled with high-level and consistent political support, there is a vast array of initiatives underway across Scottish schools, colleges, universities and workplaces to engage girls and women in STEM and to open opportunities equally. There is clearly much effort and willingness to find solutions to the barriers that inhibit women from successfully developing STEM careers.

Yet the impact of increased awareness and efforts has, to date, resulted in a mixed picture of progress. By some indicators, progress has been encouraging; by others, progress has been slow; and by some measures, no progress has yet been made at all.

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SCHOOL EDUCATION



Computing-related qualifications

SCQF levels 3–5: Proportion of pupils taking the courses who were female: **32% 2012** to **18% 2018**;
Higher Grade: Proportion of pupils sitting the examinations who were female: **25% 2012** to **16% 2018**



Physics

SCQF levels 3–5: Proportion of pupils taking the courses who were female: **27% 2012** to **26% 2018**;
Higher Grade: Proportion of pupils sitting the examinations who were female: **29% 2012** to **28% 2018**



Chemistry

SCQF levels 3–5: Proportion of pupils taking the courses who were female: **50% 2012** to **51% 2018**;
Higher Grade: Proportion of pupils sitting the examinations who were female: **49% 2012** to **53% 2018**

Source: Analysis of SQA Attainment Statistics 2012 and 2018



FURTHER EDUCATION



Proportion of students entering college STEM frameworks who were female

Engineering **13% 2012** to **28% 2017**; IT **54% 2012** to **43% 2017**

Source: Scottish Funding Council Infact Database



HIGHER EDUCATION



Proportion of Scottish-domiciled undergraduate entrants (SDUE) who were female

- Engineering **12% 2012** to **15% 2017**
- Computing Science **19% 2012** to **16% 2017**
- Mathematics **44% 2012** to **38% 2017**
- Physics **20% 2012** to **23% 2017**

Source: HESA Student Statistics 2012 and 2017

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ACADEMIC WORKPLACE

▶ Number of Scottish universities achieving Athena SWAN institutional awards for action on gender equality increased from **3 in 2012** to **14 in 2017**; with **73 STEM** departments holding awards in **2017**.

Source: Universities Scotland, April 2018, response to Tapping All Our Talents Review 2018

▶ **Proportion of professors in the UK who are female:**

- In Chemistry **5% 2008** to **10% 2017**
- In Mathematics **3% 2008** to **10% 2017**

Source: HESA Staff Statistics 2008 and 2017

▶ **Proportion of academic staff (at all levels of faculty) in Scotland who are female:**

- In Chemistry **21% 2012** to **30% 2017**
- In Computing Science **19% 2012** to **22% 2017**
- In Physics **16% 2012** to **16% 2017**

Source HESA Staff Statistics 2012 and 2017



INDUSTRY WORKPLACE

▶ **Proportion of female STEM graduates working in STEM industries in the UK** **27% 2012** to **30% 2017**. Proportion of male STEM graduates working in STEM industries: **56% 2012** to **57% 2017**

Source: Office for National Statistics, 2018, Quarterly Labour Force Survey, 1992-2018

▶ **Proportion of individuals employed in core STEM occupations in the UK who are female** **13% 2012** to **23% 2017**

Sources – WISE: Women in STEM UK Statistics 2012 and WISE: Women in STEM Workforce 2017

▶ **Proportion of professionals in the UK who are female:**

- In ICT **15% 2012** to **17% 2017**
- In Science **40% 2012** to **42% 2017**
- In Engineering **5.5% 2012** to **11% 2017**

Sources – WISE: Women in STEM UK Statistics 2012 and WISE: Women in STEM Workforce 2017

▶ **Proportion of board members in FTSE 100 companies who are female:**

- In Construction **7% 2011** to **30% 2017**
- In Scientific and Technical Activities **17% 2011** to **30% 2017**

Source – Cranfield University, 2017, The Female FTSE Board Report 2017



GENDER PAY GAP

► **Overall gender pay gap in Scotland (including both full-time and part-time workers):**
18% 2012 to 16% 2017

Source – ONS, Annual Survey of Hours and Earnings 2012 and 2017

What Next?

Addressing the root causes of gender inequality in STEM is an enormous task. The need for long-term, sustained endeavour must be recognised. But dedicated effort to stepping up the pace of change is fundamental to Scotland's economic vitality and to the wellbeing of its society. Having produced this report, the RSE looks forward to supporting further work with education providers, business, government and wider society to make further progress towards equality for women in STEM, to the benefit of Scotland and its people.

1.3 About the Report

This report considers:

- the **societal context** in which efforts to achieve gender equality take place;
- the role of **government** and public policy developments since 2012;
- developments in understanding and action on gender equality in the Scottish **education** system since 2012;
- the evolution of Scottish STEM **workplaces, both in industry and academia**, over the last six years with regard to gender equality; and
- the next steps: **recommendations** for action to increase the pace of change.

Building on the *Tapping All Our Talents 2012* report, this 2018 Review has broadened both its scope and its depth of analysis. It has taken a broad, holistic approach to gender inequality in STEM, considering the development and flow of talent from birth through the multiplicity of educational and employment pathways available, and in the institutional and societal context.

It is clear that achieving gender equality in STEM requires a complex, comprehensive web of interventions. The key recommendations identified by this Review are high level. They seek to establish the essential foundations that will enable the impact of equality initiatives to be maximised and sustained. Every individual, organisation and sector has a role to play in delivering a step change in progress towards equality. This report suggests, at the end of each chapter, actions to be considered by stakeholders in that sector. We call on these stakeholders to come together to discuss and agree a coherent plan of action on gender equality in STEM. The RSE would be pleased to help support and facilitate the collaborative discussions and actions that are necessary.

2 Gender Equality in STEM: a societal challenge

Many initiatives aimed at improving gender equality in STEM, including many of those recommended in the *Tapping All Our Talents 2012* report, have focused on addressing the consequences of education and training systems and workplaces that have historically been male-dominated. However, on their own, these are not sufficient. It is clear that **a step change in real gender equality, in STEM and elsewhere, for women and for men, will require a fundamental shift in societal and institutional perceptions of gender ‘norms’.**

Understanding of the causes of gender and sex differences is complex and ever-changing. Over previous decades, psychologists have considered both biological factors (nature) and sociocultural influences (nurture). Debate continues over the relative influence of both and, more recently, has begun to consider how the two interact.⁶

Nevertheless, it is clear that gender stereotypes are reinforced from birth, through expectations that are placed on children’s behaviour, interests and abilities, which are manifested in many ways including choices of toys and clothes. Cultural views on gendered roles in society in particular around caring responsibilities and providing financial security for families, are deeply and strongly held; i.e., “breadwinner” versus “homemaker”. Traditional and fixed perceptions of many working environments as being gender-specific are widespread, with construction, physics and engineering seen to be the domain of men, for example, and nursing, social care and childcare that of women. It is also notable that this gendered division of labour is unequal, as those occupations that are regarded as being for men typically command better pay and higher status than female-dominated roles.

Challenging these ingrained societal beliefs remains a colossal task. It demands significant, sustained effort, political leadership and resourcing. It requires buy-in from and collaboration between a broad spectrum of influencers, from traditional media to social media; advertisers to campaigners; professional bodies to community leaders; employers to investors; extended families to educationalists.

The fight for gender equality has a long and rich history. This year, 2018, marks 100 years since some British women gained the right to vote. Public interest has waxed and waned over the years, but 2018 has seen some encouraging developments that have once again brought the issue to the fore. High-profile female leaders (in Scotland and the UK), political leadership, gender pay gap reporting, the #metoo campaign and social media more widely, have all contributed to greater focus on gender equality, a stronger voice and media presence for women and created space for society-wide conversations on gender issues.

The challenge is to capitalise on the current momentum. We need to redouble our efforts to deliver the structural and institutional changes that are necessary to secure lasting gender equality and ensure they are sufficiently robust to withstand changes in leadership, the inevitable loss of limelight and inertia in the face of tremendous difficulty and slow progress.

⁶ See, for example, Eagly, A. H. and Wood, W., 2013, *The nature-nurture debates: 25 years of challenges in understanding the psychology of gender*



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There is no single or simple solution to effect institutional and societal change. Policy makers work closely with social scientists to employ various combinations of, for example, education, communication, legislation and ‘choice’ architecture (nudging) to change ingrained behaviours, with varying degrees of success. However, we believe there is an overwhelming case that:

- 1 Gender inequality, including gender inequality in STEM, must be considered and approached as a societal issue.** Entrenched gender stereotypes restrict the potential of all our children from birth, shaping and limiting the contribution that individuals can make to both our society and our economy. Perpetuating barriers that prevent girls and women from excelling in areas in which they have natural interest and ability is not only a social injustice but also narrows the pool of talent available to employers. This hampers productivity and innovation in many of Scotland’s most important growth sectors. Undervaluing the importance of caring roles, whether paid or unpaid, combined with societal expectations on men to be high achievers (i.e., high earners) will continue to direct boys away from caring professions. It places intangible yet powerful pressure on fathers to minimise the impact of family responsibilities on their jobs. Efforts have been made to quantify the economic loss of underutilisation of women’s skills,⁷ but the breadth and depth of the wider impact of gender inequality on our society, while difficult to quantify accurately, cannot be overestimated.
- 2 Challenging gender inequality needs universal buy-in:** it is not a ‘women’s problem’, nor that of any one individual sector. It cannot be addressed in classrooms and workplaces alone: societal norms and values influence both individual choices and organisational culture. Creating a society which facilitates and promotes gender equality, and is intolerant of discrimination or unacceptable behaviours, requires leadership at all levels. It will be underpinned by legislation that protects and promotes women’s rights and that proactively addresses entrenched gendered roles, such as mothers as primary carers for their children. It will rely upon the media to take a leading role in responsibly using its significant influence on societal beliefs. But gender equality can only become the ‘norm’ when everyone – individuals and influencers – understands that equality and diversity benefit us all and takes personal responsibility to act accordingly.

Such an holistic approach can deliver real progress: Scotland’s preventative approach to reducing knife crime, for example, tackles societal issues such as poverty, toxic masculinity and alcohol abuse, and has had marked success.⁸

The *Tapping All Our Talents Review 2018* focuses on progressing equality for girls and women in STEM in Scotland, but it does so within this broad societal context, mindful of the need for equality across all sectors, roles and responsibilities, for women and for men.

⁷ See, for example, McKinsey Global Institute, 2015, *The Power of Parity: how advancing women’s equality can add \$12trillion to global growth*.

⁸ For more information, see <https://civilservice.blog.gov.uk/2018/05/24/tackling-knife-crime-in-scotland-10-years-on/>

3 Gender Equality in STEM: the role of Government

Scottish Government should: take the lead in committing itself to a national strategy for Scotland – an Action Plan – aimed at retaining and promoting women in STEM and led by a Cabinet Secretary; reaffirm its commitment to close the gender pay gap; and expect university STEM departments to achieve the minimum standards for an Athena SWAN Silver award, or equivalent. Initiatives should be monitored and evaluated.

Tapping All Our Talents, April 2012, p7

3.1 Government: findings and recommendations 2012

Tapping All Our Talents 2012 recognised that “while not all aspects of public policy are devolved to Scotland, the Scottish Government has responsibilities that cover policy areas where it can influence gender equality in STEM, such as education, training and economic development”.⁹ It welcomed a number of actions taken by Government to promote the engagement of women in STEM, but raised concerns that no action had yet led to significant change or gender mainstreaming.

The 2012 Report’s recommendations called on the Scottish Government to:

- 1 Provide political leadership through a National Strategy on occupational segregation;
- 2 Use levers such as the Public Sector Equality Duty and procurement to drive gender equality within the public sector and across its suppliers;
- 3 Commit to action on the gender pay gap;
- 4 Ensure provision of affordable, high-quality childcare;
- 5 Improve the availability of gender-disaggregated occupational data; and
- 6 Ensure sufficient resourcing for initiatives to tackle occupational segregation.

Recommendations to the UK Government were to:

- 7 Amend employment law to recognise the equal responsibility of mothers and fathers in parenting;
- 8 Appoint a ministerial ‘Gender and STEM’ government champion; and
- 9 Require headhunters to put forward equal numbers of male and female candidates for top public sector positions.

⁹ The RSE, April 2012, *Tapping All Our Talents – Women in STEM: a strategy for Scotland*, p15

3.2 Government: developments since 2012

3.2.1 Scottish Government: strategies and interventions on gender equality

Over the past six years, the Scottish Government has been strongly committed to improving gender equality in Scotland. The current First Minister has vocally championed equality and diversity since her appointment in 2014, providing visible leadership through, for example, a gender-balanced Cabinet. Rhetoric has been supported by a range of legislative and policy commitments, with a focus on women in the workplace.

Both the Scottish Government's flagship Economic Strategy (2015)¹⁰ and Labour Market Strategy (2016)¹¹ identify tackling inequality and strengthening inclusive growth as key pillars of a successful Scottish economy. Scottish Government actions relating to gender inequality include:

- On-going **funding of third sector bodies focused on addressing occupational segregation**, including Equate Scotland (formerly the Scottish Resource Centre for Women in Science, Engineering and Technology), Close the Gap and Family Friendly Working Scotland.
- May 2012: Introduction of **Scottish-Specific Duties under the Public Sector Equality Act** that include requirements on listed public authorities to publish equality outcomes and progress; report activity on mainstreaming the equality duty; provide gender pay gap information (where the public body has more than 20 employees); and issue statements on equal pay.
- October 2012: The formation of a **Strategic Group on Women and Work** and, from November 2017, an **Advisory Council on Women and Girls** to advise Government on gender equality issues.
- 2015: The establishment of the **Fair Work Convention**, which published a **Fair Work Framework for Scotland** (2016). The Framework makes recommendations to employers on promoting fair workplaces around five dimensions of effective voice, opportunity, security, fulfilment and respect.
- 2015: **Launch of the Partnership for Change - 50/50 by 2020** campaign which encourages public, private and third sector organisations to voluntarily commit to improving gender balance on boards, and which currently has over 200 signatories.
- February 2018: Opening a one-year **Workplace Equality Fund** of £500,000, providing grants to private businesses to reduce employment inequalities, discrimination and barriers for minority ethnic people, women, disabled people and older workers.
- March 2018: Introduction of the **Gender Representation on Public Bodies (Scotland) Act** which sets a target of equal representation of women in non-executive roles on the boards of public bodies, colleges and Higher Education Institutions; and which places a duty on public bodies to take steps to encourage women to apply for non-executive positions.
- 2020: commitment to **expanding provision of free childcare** for three and four year olds, and eligible two year olds, from 600 hours per year to 1,140 hours by 2020.

In Autumn 2017, the Scottish Government published its **STEM Education and Training Strategy**.¹² This recognises both the importance to Scotland of developing a high-quality, innovative and vibrant STEM sector, and the need to tackle gender imbalances and other inequalities to enable it to do so. It sets closing equity gaps in participation and attainment as one of four key aims of the strategy.

¹⁰ Scottish Government, March 2015, *Scotland's Economic Strategy*.

¹¹ Scottish Government, August 2016, *Scotland's Labour Market Strategy*.

¹² Scottish Government, October 2017, *Science, Technology, Engineering, Mathematics – Education and Training Strategy for Scotland*.

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3.2.2 UK Government: gender pay gap reporting

A key UK legislative development in relation to gender equality in the workplace is the requirement on large companies and public sector bodies to publish annually their gender pay gap. The Equality Act 2010 (Gender Pay Gap Information) Regulations 2017, which apply to private and voluntary sector organisations with 250 or more employees; and the Equality Act 2010 (Specific Duties and Public Authorities) Regulations 2017, which apply to public bodies with 250 or more employees, were passed in April 2017. The first round of reporting was required by April 2018. Annual reporting requirements include calculations of average pay gaps between male and female staff, average pay gaps in relation to bonuses, and the gap in proportion of men and women receiving bonuses.

The aims of this intervention are to drive employers to identify and centralise discussion on gender pay issues within their organisations and sectors; stimulate public discussion; and provide a baseline from which the figures can be improved. While the gender pay gap is separate to the issue of unequal pay (in which a man and a woman are paid a different amount for doing the same job, made illegal under the Equal Pay Act 1970), it does usefully illustrate the structural issues that both underlie and result from occupational segregation. The potential impact of gender pay gap reporting is discussed further under Section 3.3 Government: key findings.

3.2.3 UK Government: shared parental leave

From April 2015, UK legislation has given parents the right to shared parental leave (SPL) following the birth of their child. After two weeks of mandatory maternity leave, eligible couples can choose to share up to 50 remaining weeks of their child's first year, with statutory shared parental pay at similar rates and under similar conditions as statutory maternity pay. Some employers may offer enhanced shared parental pay packages as an employee benefit.

The aim of this legislation is to 'de-gender' childcare responsibilities in an era in which the majority of families have both parents in work.

The clear aspirations for gender equality and growing focus on policy initiatives from both UK and Scottish Governments are welcome. But it is crucial that implementation and impact of such initiatives are monitored, to ensure that the desired outcomes are achieved. We comment below on our current findings in respect of the efforts of government to improve gender equality.

3.3 Government: key findings 2018

3.3.1 Political leadership on gender equality in STEM

Throughout our consultation, strong leadership from the Scottish Government was widely identified as a key positive driver of efforts to tackle gender inequality and occupational segregation in STEM. The focus on gender equality as an element of inclusive growth was seen to have raised the profile of the challenges women face in the STEM workforce, and in the workplace more widely.

However, while welcoming greater awareness and activity, respondents contended that "*evidence would suggest this must be driven faster and further to achieve impactful change*".¹³

¹³ Colleges Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation.

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Two clear, consistent messages emerged throughout this review. They are fundamental to achieving a step change towards gender equity. The Scottish Government, as a policy maker and as an employer, has a leadership role to play in both.

i) Gender equality must be embedded within institutional culture

The first key message is that true equality can only be realised when the value of equality and diversity is embedded within the culture of every sector, and every organisation. Respondents to this consultation spoke of ‘meaningful mainstreaming’ as a radical but necessary shift in approach.¹⁴ This requires leadership, engagement and commitment at every level of institutions, to challenge deep-rooted attitudes and cultural norms. It calls for the investment of energy, time and resources into identifying and addressing the structures and processes that perpetuate gender (and other) inequalities. And, within the public sector, it means “*gender competence and gender equality inclusion across policy making... and with gender analysis applied to all policy making*”.¹⁵

Government alone can be the linchpin of an “*integrated, collaborative, multi-sector strategy for culture change*”¹⁶ in Scotland. It is only government that can ensure that all legislation and every policy that impacts on life and work in Scotland has gender equality at its core. While some of this legislation and these policies rest with the UK Government, the Scottish Government is uniquely placed to advance this cultural shift in Scotland. Without its leadership, mainstreaming is unlikely to happen.

Through the interventions listed in Section 3.2, the Scottish Government has driven the equalities agenda far beyond the remit of a dedicated equalities team within government. They compel officials responsible for policy development in a wide range of areas to consider the impact of their proposals on groups with protected characteristics. This widening of awareness and discussion is a hugely positive step towards mainstreaming. But it has not yet led to a significant culture shift in which equalities competence is ingrained in every individual and embedded as the fundamental foundation of policy development. The risk of relying solely upon additional requirements, such as Equality Impact Assessments, is that they become perceived as burdensome, and evolve into a tick-box exercise.

In addition to embedding equalities into their own organisational structures, the Scottish Government and its agencies hold a wide selection of levers that can influence, stimulate and encourage behaviour change across sectors. These range from legislative measures and national targets, to curriculum development, research funding and procurement. Recent years have seen advances in the use of some of these levers to tackle gender equality, many of which are discussed elsewhere in this report. But they fall short of a strategic, coherent approach to support embedding gender equality across Scotland’s education system and workplaces.

ii) The need for strategic oversight of action on gender equality

The second key message is that strategic oversight is needed to advance a step change in gender equality in STEM. When exploring gender inequality initiatives in STEM, a picture of great willingness, enthusiasm and effort quickly emerges. There is a myriad of actions and projects underway across Scotland’s schools, colleges, universities, workplaces and communities, many of which are recognised as successful by their own measures.

¹⁴ Colleges Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation.

¹⁵ Equate Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation.

¹⁶ University of St Andrews, April 2018, response to *Tapping All Our Talents Review 2018* consultation.

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While this energy and dedication is welcome, it has not, to date, resulted in the step change required to secure gender equality within an acceptable timescale. Two factors have emerged for this. The first is the ***“lack of robust evidence-based data-gathering to determine the success of individual intervention strategies... and to assess the relative merits of interventions and evidence of effectiveness”***.¹⁷ This lack of monitoring and evaluation was widely recognised as impeding the ability to identify which actions are impactful; and which could effectively be replicated and scaled up to a level at which their impact is reflected in national indicators.

The scarcity of evaluation data from long-term initiatives and longitudinal studies was specifically recognised as a barrier to real understanding of what works and what does not work.¹⁸ Short-term funding precludes long-term evaluation, while targets measured on short timescales direct focus towards quick wins that may have little meaningful or long-term impact. This represents a significant gap in knowledge of how to achieve sustainable, consistent and large-scale progress.

The second factor is the **absence of an integrated, collaborative, national-level approach to tackling gender inequality in STEM**. Short-term, localised initiatives may be successful for small numbers of girls and women, but the absence of strategic oversight leads to much duplication of effort and resources, while limiting the opportunities to share learning and expertise on both good practice and bad.

Efforts to encourage individuals and organisations to tackle gender inequality – in numbers that will make a perceivable difference – must be matched by support that makes it as easy as possible for them to take effective action. The Scottish Government, working in partnership with professional bodies, representative bodies and the third sector, is again ideally positioned to develop a centralised resource that can provide such support.

This resource could take the form of a national database that pools up-to-date understanding of the effectiveness of initiatives; that celebrates and shares best practice; that provides models relevant to a wide range of organisation types and sizes; or that develops properly costed frameworks of what it takes to shift culture.¹⁹ It may mean the creation of mechanisms, such as highly-regarded and well-rewarded secondments, to share expertise.²⁰ And it should lead to more strategic use of resources: leveraging of private sector investment, minimising duplication and avoiding repetition of costly mistakes or investment in initiatives with limited impact.

3.3.2 Use of levers such as the Public Sector Equality Duty and procurement to drive gender equality across the public sector and beyond.

The public sector in Scotland employs almost 600,000 people.²¹ Its performance in tackling gender inequality, alongside other inequalities, both directly impacts a substantial proportion of Scotland's workforce (over 20%) and sets a precedent for other employers to follow. For this reason, *Tapping All Our Talents 2012* recommended that *“The Scottish Government should pursue its aim of improving the operation of the Public Sector Equality Duty through the introduction of Specific Duties”* and that *“the government should lead by example in fully implementing the Public Sector Equality Duty in its own departments and agencies”*.²²

¹⁷ Colleges Scotland, April 2018, response to Tapping All Our Talents Review 2018 consultation.

¹⁸ See, for example, Close the Gap, Universities Scotland, Equate Scotland, Heriot-Watt University, Primary Engineer, April 2018, responses to *Tapping All Our Talents Review 2018*.

¹⁹ Individual response to *Tapping All Our Talents Review 2018*.

²⁰ Ibid

²¹ Scottish Government, April 2017, *Equality Outcomes and Mainstreaming Report 2017*.

²² The RSE, April 2012, *Tapping All Our Talents*, p30

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As we have seen under Section 3.2, the Scottish Government subsequently introduced Scottish-Specific Duties. This includes requirements on listed public authorities to publish gender pay gap information and to report on progress towards equality. Under these duties, the Scottish Government identified an Equality Outcome that *“women’s position in the economy and in employment is improved in the long term and reflected more comprehensively in Scottish Government economic policy and strategies by 2017”*.²³ Many of the policy developments outlined above have been designed to support this Outcome. Two key indicators of progress – the gender pay gap and the female employment rate – suggest there has been slow but measurable improvement; for example, with the overall pay gap reduced from 18% in 2013 to 16% in 2016; and the female employment rate increasing from 66% in 2013 to 70% in 2016.

As an employer, the Scottish Government itself has made some welcome advances in gender equality. It has taken a range of steps; for example, around recruitment and promotion processes, flexible working practices and employee engagement, to enhance equality.²⁴ It reports that, in 2016, women accounted for 59% of public appointments and held over 45% of board positions, while the proportion of women at Senior Civil Service level within core Scottish Government staffing increased from 40% in March 2015 to 45% in September 2016.²⁵

But in parallel to this success, biennial reports published by Scottish public authorities under the Duties identify issues of significant and persistent concern. Analysis of these reports undertaken by Close The Gap, the Scottish Government-funded charity working on women’s participation in the workplace, highlights concerns over widespread poor data collection, analysis and use; low understanding of gender equality issues; and a sense of complacency. Of particular concern was that, in many cases, there has been no action on shortcomings that were identified in initial progress reports (2013), such as insufficient data collection systems.²⁶

While the Scottish Government rightly expects public authorities in Scotland to comply with and exceed the obligations set out in the Equality Act 2010, it is evident that improvement needs to be made on robust reporting, monitoring and accountability under the Scottish Specific Duties.

Similarly, regarding its position as a purchaser of goods and services, the Scottish Government advises that it expects its contractors to demonstrate compliance with equality legislation, and to adopt fair work policies, including a positive approach to equal pay.²⁷

Guidance and support on fair work and procurement are welcome, particularly where they explicitly address gender equality and the gender pay gap. But, as with the Public Sector Equality Duty, it is how compliance with legislation and guidance is monitored and enforced that will determine its impact on equality in the workplaces of suppliers to the public sector.

²³ Scottish Government, April 2017, *Equality Outcomes and Mainstreaming Report 2017*.

²⁴ Ibid

²⁵ Ibid

²⁶ Close the Gap, November 2015, *Making Progress? An assessment of public sector employers’ compliance with the public sector equality duty*.

²⁷ Scottish Government, January 2018, correspondence with the RSE.

3.3.3 Provision of high-quality, accessible childcare

The provision of high quality, accessible, wrap around childcare – for early years and primary school children – was one of the most commonly identified requirements for enabling gender equality in the workplace in responses to this Review. While such a development would benefit all parents, its impact would be significantly greater on women, who take on a disproportionate share of childcare responsibilities. Analysis by the Office of National Statistics in 2016 found that, on average, women were undertaking 60% more unpaid work – including childcare and household chores – than men: some 24 hours each week, compared to the 16 hours delivered by men. Indeed, women aged 24–35, those likely to have young families, were undertaking the most unpaid work of any age category, at 35 hours per week.²⁸

The Scottish Government's commitment to expanding provision of free childcare for all three and four year olds and for eligible two year olds from 600 hours per year to 1,140 hours by 2020 has the potential, therefore, to make a significant contribution to tackling gender inequality in STEM. At the same time, there remain serious challenges of implementation. An Audit Scotland report in February 2018 identified 'significant risks' to the policy; in particular the large increase needed in the number of childcare staff, changes required to premises housing childcare facilities, and disagreement among stakeholders over the costs of providing expanded care.²⁹ The Scottish Government must continue to work closely with local authorities and childcare providers to deliver solutions to issues of funding, capacity and professional development of staff.

Certainly, the current limited and inflexible allocation of 600 funded hours per year is not sufficient to support women to remain in full-time positions, even when they want to do so. Parents are therefore faced with the choice of paying considerable additional childcare costs,³⁰ relying on grandparents (who may, themselves, leave the labour market early to provide such care),³¹ or having one parent (most frequently the mother) reduce their working hours. As we consider in Section 6, the lack of quality flexible or part-time positions available in Scotland means that women often have little option but to accept working positions for which they are over-skilled and under-paid; and which have a long-term negative impact on their career progression.

It must be acknowledged that the number of free childcare hours offered from 2020 will not, on its own, allow parents to work full-time. It may, however, make the burden (financial or by outsourcing to family members such as grandparents, for example) of additional hours of childcare more manageable. However, for expanded free childcare provision to truly support women to remain in or return to employment, it must be designed to be accessible and sufficiently flexible to meet the demands that employers place on their staff. Employees may be expected to be present within certain contracted core hours, but they may also be expected to take on flexible shift patterns or to be available at short notice outwith core hours. In some STEM areas, where, for example, experiments must be monitored over extended time periods, this can be a specific barrier to uptake of roles by women.

²⁸ Office for National Statistics, 10 November 2016, *Women shoulder the responsibility of unpaid work*, <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/articles/womenshouldtheresponsibilityofunpaidwork/2016-11-10>

²⁹ Audit Scotland, February 2018, *Early learning and childcare*.

³⁰ See, for example, Early Years Scotland, 6 March 2017, *Cost of childcare in Scotland up by 4.5%*, <https://earlyyearsscotland.org/blog/cost-of-childcare-in-scotland-up-by-4-5>

³¹ See, for example, Bank of Scotland, 12 April 2018, *Sums add up for the support provided by Scottish grandparents*, <https://www.lloydsbankinggroup.com/globalassets/bank-of-scotland---sums-add-up-for-the-support-provided-by-scottish-grandparents.pdf>

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Expanded childcare for pre-school children does not offer support for parents with younger babies and toddlers, or those of school-age children who struggle to access wrap-around and holiday care, for reasons of both affordability and availability. The Scottish Government has committed to implementing pilot schemes aimed at reducing the burden of upfront childcare costs for families, focusing on a deposit guarantee scheme.³² It has also committed to developing a new framework for Out of School Care. The development and eventual design of both of these interventions will be crucial to determining how well women are supported to remain active in the workplace, at levels which match their capacity and skills, throughout the journey of raising a young family.

3.3.4 Action on the gender pay gap

Many respondents to this review identified the persistent gender pay gap as one of the most important issues that continues to undermine gender equality in STEM.³³

The first publication round under UK gender pay gap reporting legislation drew significant media scrutiny. With just over 10,000 companies and public sector organisations complying with requirements by the April 2018 deadline, the current national average median pay gap is calculated as 18%, with some 78% of companies paying men more than women.³⁴ But there are substantial differences between sectors. The biggest gender pay gap is in Construction, with an average median gap of 25% and a particularly high bonus pay gap.

In Scotland in 2017, the full-time gender pay gap (the official measure used by the Office of National Statistics) was less than 7%, considerably reduced from 18% in 1997. However, the overall pay gap – including both full-time and part-time workers – was 16%, having been largely stable over the past ten years.³⁵ Many believe that the overall pay gap figure is more representative, as excluding part-time workers from the calculation discounts 40% of female workers.³⁶ The Scottish Parliament's Economy, Jobs and Fair Work Committee recently recommended that the Scottish Government changes the way it measures and reports the gender pay gap in the National Performance Framework, to take part-time workers into account.³⁷

Coinciding with high profile campaigns such as #metoo and #timesup, pay gap reporting has been seen as a broadly successful prompt for society-wide discussion and public awareness of gender inequality issues in the workplace, including pay, discrimination and persistent inappropriate and unacceptable behaviours. It has highlighted the extent to which women are over-represented in lower paid occupations; under-represented in senior roles; and occupy part-time positions – often available only at lower level and lower pro-rata pay than matches their skills and experience – due to undertaking an unequal share of caring responsibilities.

³² Scottish Government, January 2018, correspondence with the RSE.

³³ See, for example, Institute of Physics, University of St Andrews, Primary Engineer, Scottish Science Advisory Council, University of Strathclyde, University of the Highlands and Islands, University of Dundee Athena SWAN and individuals, April 2018, responses to the *Tapping All Our Talents Review 2018* consultation.

³⁴ Business, Energy and Industrial Strategy Commons Select Committee, August 2018, Gender pay gap reporting.

³⁵ Scottish Government, November 2017, Scotland Performs National Indicator: Pay Gap, <https://www.gov.scot/About/Performance/scotPerforms/indicator/paygap#data>

³⁶ Scottish Parliament, Economy, Jobs and Fair Work Committee, June 2017, *No small change: the economic potential of closing the gender pay gap*.

³⁷ Ibid

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The absence of a legislative requirement on employers to act on identified gender pay gaps, however, is considered to be a limitation on the effectiveness of this intervention³⁸. Close The Gap advised that in recent research in Scotland, 94% of employers surveyed had an equal pay policy in place, but less than a third had undertaken an equal pay review and fewer than 3% had taken any action to address the identified pay gaps.³⁹

The comparison of next year's reporting to the 2018 baseline will indicate whether this legislation has driven employers to act to address their gender pay gaps, and whether their actions have had the desired impact.

3.3.5 UK employment law: shared parental leave

Despite the introduction of shared parental leave in 2015, recent studies show that only between 1% and 3% of eligible couples have taken advantage of this right.⁴⁰ At February 2018, the UK Government estimated that around half of the public was unaware of the option; while results of a Working Families survey in 2017 suggested that more than a third of eligible couples couldn't afford it, not least where they experience a pre-existing gender pay gap. Further research found that many fathers were concerned about the cultural stigma and negative perceptions from employers around requests to take shared parental leave.⁴¹

UK policy-makers always expected uptake of shared parental leave to be low in the first few years, due to lack of awareness and to financial, cultural and workplace barriers. Critics, however, suggest that offering shared parental leave only as an option will never be a sufficient driver to overcoming these barriers, or encourage genuine sharing of childcare responsibilities between parents. One expert commented that *"The British Government's failure to propose a more forceful 'use it or lose it' structure, designed to create incentives and not just rights, means this well-intentioned effort to de-gender childcare rings hollow"*.⁴²

When Sweden introduced shared parental leave in 1974, take up there was also low, at around 5%. However, it has since introduced specific, non-transferable time off for fathers, alongside equality bonuses to encourage parents to share leave more equally and an allowance of 80% of salary for the first 390 days of the 480 days leave that are available. These incentives have seen the number of men taking some time off rise to around 85%.

The UK Government will carry out an evaluation of shared parental leave legislation later this year. It is vital that consideration is given to how a shift in societal perceptions on childcare responsibilities can truly be achieved. Adopting what appears to be current best practice developed in other jurisdictions may be a shortcut to success.

³⁸ Equate Scotland and Close the Gap, April 2018, response to *Tapping All Our Talents Review 2018* consultation.

³⁹ *Close the Gap*, April 2018, response to *Tapping All Our Talents Review 2018* consultation.

⁴⁰ BBC News, 12 February 2018, Shared Parental Leave take-up may be as low as 2%, <https://www.bbc.co.uk/news/business-43026312>

⁴¹ Ibid

⁴² The Guardian, 4 April 2015, *It's a new era of shared parental leave (if you can afford to take it)*, <https://www.theguardian.com/lifeandstyle/2015/apr/04/shared-parental-leave-new-era-gender-equality-workplace>

3.3.6 Availability of data and intersectionality

Tapping All Our Talents 2012 called on the Scottish Government to improve availability and dissemination of gender disaggregated statistics covering women in STEM; in order to **establish a clear picture of the current status of gender equality**, and a better understanding of barriers to equality. The Scottish Government undertook its own evidence review in 2017 to underpin the STEM Education and Strategy, and this called for further investigation and data analysis, including on women in STEM.⁴³

The Scottish Government has identified work to be carried out under the STEM Education and Training Strategy that will look at the factors that contribute to the loss of people from the STEM skills pipeline; and will involve collation and new analysis of data and information about how people move through STEM education and training and on into the workplace.⁴⁴ The Government will also report on three Key Performance Indicators set out in the Strategy, related to gender balance in STEM subjects at SCQF level 6, in Further and Higher Education, and in uptake of STEM-related apprenticeships.

In tandem, the Fairer Scotland Action Plan (October 2016), committed the Scottish Government to exploring the development of a Gender Index Report to bring together a range of indicators on the inequalities facing men and women in Scotland. This work is on-going, but we welcome the recognition in a recent progress report that “*consideration could be given to the Scottish Index measuring the STEM sectors to better align with policy focus*”.⁴⁵

These developments may go some way towards responding to repeated calls for improved availability of data that allows for:

- i) The creation of a realistic baseline of current gender equality in STEM, against which progress can be regularly measured.
- ii) Better understanding of the root causes of gender inequality in STEM. As one respondent noted, “*improving quality of access to data makes issues visible and starts informed conversations that can effect change*”.⁴⁶

But there is more to be done to establish a clear picture of gender equality – or inequalities – in the workplace, and how this is evolving over time. Current gender pay gap reporting requirements in the UK apply to organisations with more than 250 employees. Fewer than 1% of UK firms fall into this category, although such large firms account for 40% of all employment.⁴⁷ This implies that 60% of workers are employed in firms which are not required to report equality data.

It is also clear that issues of **intersectionality** must be considered alongside gender equality, recognising that people’s identities and experiences are moulded by multiple factors. For many girls and women, barriers to entering and progressing in STEM are shaped not only by gender but by a complex web of characteristics, such as race, ethnicity, socio-economic background and/or disability status. The Young People in Scotland Survey 2017, for example, found that those from the most deprived areas were less likely than those in the least deprived areas to report that they had chosen, or intended to choose, to study a STEM subject (57% vs. 71%).

⁴³ Scottish Government, October 2017, *Science, Technology, Engineering and Mathematics (STEM) Evidence Base*, p16.

⁴⁴ Scottish Government, January 2018, correspondence with the RSE.

⁴⁵ Scottish Government, September 2017, *A Gender Index for Scotland Working Paper*, p8.

⁴⁶ University of Dundee Athena SWAN, April 2018, response to *Tapping All Our Talents Review 2018* consultation.

⁴⁷ House of Commons Library, December 2017, Business Statistics briefing paper.

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Yet the current paucity of intersectional data, and sources of such data, precludes meaningful understanding of often vastly different experiences of groups of women in STEM; or the development of suitably tailored initiatives to drive equality for all women in the sector. There are challenges to collecting and analysing intersectional data in a way that can truly represent people's experiences without the risk of identifying individuals. Even the largest surveys in the UK are currently unable to provide sufficiently large sample sizes. Yet this is a stark gap in Scotland's equality evidence base and must be addressed urgently. In this time of 'big data', one channel to explore is improving access for researchers to anonymised administrative data, e.g. those held by public bodies such as HMRC, to allow for analysis at a larger scale. Another may be developing the requirements on employers' duties to gather and share data: requiring pay gap reporting by gender and ethnicity would be one example.

This does, of course, rely on people reporting protected characteristics in response to national surveys or to employers. While respecting the right of individuals to choose what they report, more could be done to highlight the usefulness of these data and to encourage people to provide them.

There has been some recent progress on adopting an intersectional approach to identifying and addressing barriers to gender equality in the Further and Higher Education sector. The Athena SWAN Charter, Race Equality Charter and the Scottish Funding Council (SFC) now include principles and requirements on intersectionality. SFC states that it will ensure that specific equality initiatives consider all protected characteristics and support intersectionality,⁴⁸ and that its reporting will include intersectional data where possible.⁴⁹

Another area in which this Review heard repeated calls for action is in **better understanding of the effectiveness of initiatives designed to tackle gender inequality in STEM**. We discuss above the need for strategic oversight to ensure that the focus is on identifying and scaling up the equality initiatives that have greatest impact. Yet there is often little robust or meaningful evaluation of the plethora of activities being undertaken; and inconsistent sharing of the learning that is available. Public funding will be instrumental to achieving a step change on gender equality,⁵⁰ but it is vital that such funding is targeted to achieve maximum impact. This may mean shifting towards the provision of long-term, stable funding that allows organisations to plan effectively for the longer term; or support for properly-evaluated longitudinal studies that will enhance our understanding of the issues. Mapping out current activity and evaluating what works will be key to enabling effective resourcing decisions.

While statistics will be a key aspect of measuring progress on gender equality in STEM, it must be borne in mind that numbers will only give a partial view of the whole picture. If Scotland's aim is to achieve a culture shift on equality, both in society and within organisations, then **an understanding of intangible elements will be equally as important**. The Scottish Government has funded the discrimination module of the Scottish Social Attitudes Survey (SSAS) to identify shifts in discriminatory attitudes in Scotland.⁵¹ A regular review of women's experiences in STEM and capturing shifts in perception and attitudes of women, men, girls and boys towards both equality and STEM through qualitative measures, whether through the SSAS or through another channel, would provide a rich narrative that allows for deeper and more nuanced understanding of progress towards culture change.

⁴⁸ The Scottish Funding Council, October 2017, University Outcome Agreement Guidance 2018-19, p22.

⁴⁹ The Scottish Funding Council, May 2018, *Report on Widening Access 2016-17*

⁵⁰ Information on current support for interventions and third sector bodies can be found in the Scottish Government's *Equality Outcomes and Mainstreaming Progress report*.

⁵¹ Scottish Government, September 2016, *Scottish Social Attitudes 2015: Attitudes to discrimination and positive action*

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UK and Scottish Governments: actions to consider for progressing gender equality in STEM

- Enhance **monitoring and accountability** to ensure that organisations fully comply with legislative and statutory equalities requirements, such as the Public Sector Equality Duties and gender pay gap reporting, in spirit and in letter.
- Ensure that **expanded childcare provision** in Scotland by 2020 is designed to be sufficiently flexible to meet the demands of parents and employers.
- Extend **pay gap reporting requirements**, for example broadening the requirements to include smaller employers; requirements to monitor and report on other protected characteristics; and requirements on employers to take action on their gender pay gap.
- Review UK legislation on **shared parental leave** to explore international models that feature non-transferable leave for fathers and mechanisms to reduce the impact of parental leave on family income.
- Develop a **national database of gender equality initiatives and their effectiveness**, that assesses different types of intervention according to the robustness of the evidence, their effectiveness and value for money (similar to the What Works Scotland approach for supporting effectiveness in public services).



4 Gender Equality in STEM Education and Training: early years, primary and secondary education

Tapping All Our Talents 2012 focused on employment of female STEM graduates in the STEM workforce, recognising the debilitating impact of the loss of talent represented by the high attrition rate of women from the STEM workforce. Breaking down the barriers to gender inequality in the workplace should encourage more women to consider STEM careers. But if we are to achieve the required step change in the number of women in the STEM workforce, equal effort must be directed at improving the number of girls and young women coming through STEM education and training.

Addressing the severe under-representation of females in some STEM subjects has long been an active space, yet the data below reflect little or no progress. The education and training system must ensure that all young people are given equal opportunity to explore their interest in STEM and are supported equally to progress their STEM learning through school and beyond.

The *Tapping All Our Talents 2018* Review Group, therefore, considered it essential to widen the scope of the Review to consider not only the STEM workplace but also the barriers that currently restrict female participation in certain STEM areas in schools, colleges, universities and workplace learning.

Representation of girls and young women in SQA qualifications in STEM subjects

At national level, in proportional terms, female participation in STEM subjects at school has broadly remained stable over recent years (Figures 1 and 2). It is, however, important to note that national qualifications in Scotland have undergone significant reform in recent years, and the new national courses that students typically study for at around age 16, for example National 4 and 5, are substantially different to the previous Standard Grades. Notwithstanding, it is possible to examine the trends in the proportion of females presenting for STEM qualifications over time.

Figure 1: Female representation at SCQF levels 3 – 5⁵² in STEM in Scotland, 2012 to 2018

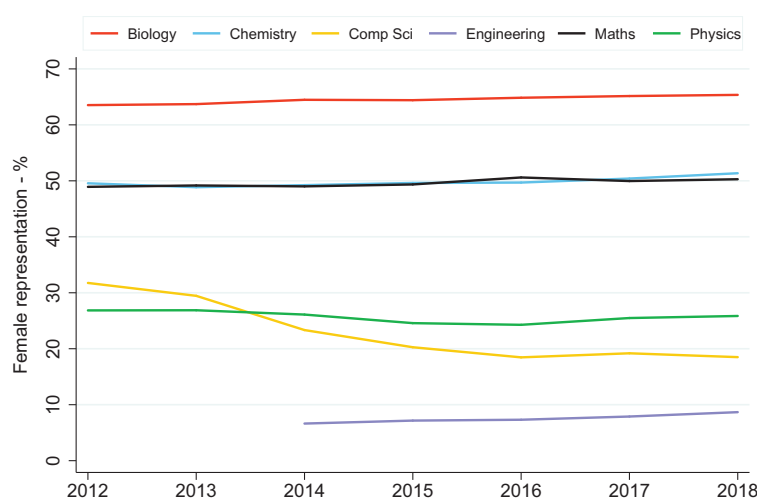


Figure 1 Source: SQA Attainment Statistics 2012 to 2018

⁵² SCQF levels 3 – 5 comprises those courses that can broadly be considered equivalent level to Standard Grade, including the National 3, 4 and 5 courses and the Intermediate courses



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Figure 2: Female representation at SCQF level 5 in STEM in Scotland, 2014 to 2018

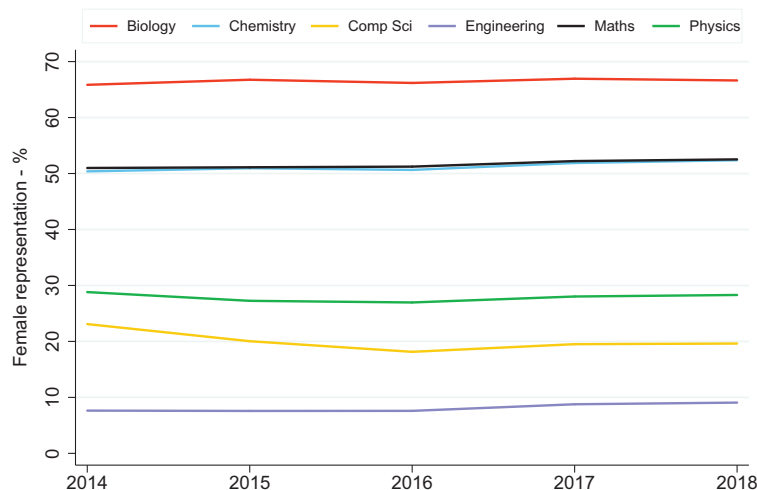


Figure 2 Source: SQA Attainment Statistics 2012 to 2018

Figure 1 illustrates the trend in the proportion of females presenting for SCQF level 3-5 qualifications (i.e., those that are broadly equivalent to previous Standard Grade Foundation, General and Credit levels) in STEM between 2012 and 2018. Figure 2 shows the proportion of females presenting for SCQF level 5 qualifications (i.e., National 5 and Intermediate 2, which are broadly equivalent to Standard Grade Credit level, and would typically be a stepping-stone to Highers) in STEM since the introduction of the new national qualifications in 2013/14.

Figures 1 and 2 show that girls continue to be over-represented in Biology, approximately equally represented in Chemistry and Mathematics, and under-represented in Engineering Science,⁵³ Computing and Physics. There is a very slight upward trend between 2012 and 2018 in the proportion of girls presenting for SCQF level 3-5 qualifications in Biology, from 64% in 2012 to 65% in 2018; and at SCQF level 5, from 66% in 2014 to 67% in 2018. The proportion of females studying Chemistry at SCQF levels 3-5 has increased from 50% in 2012 to 51% in 2018; and at SCQF level 5, from 50% in 2014 to 52% in 2018. The picture is very similar for Mathematics, where female entries at SCQF levels 3-5 have increased from 49% in 2012 to 50% in 2018; while at SCQF level 5, presentations have increased from 51% in 2014 to 53% in 2018. As for Physics, the proportion of female entries has remained stable, with females comprising 26% of presentations at SCQF levels 3-5 in 2018 compared with 27% in 2012; and 28% of SCQF level 5 presentations in 2018, compared with 29% in 2014.

Of note, is the substantial decline in the proportion of girls taking computing-related⁵⁴ qualifications at SCQF levels 3-5, where female representation has decreased from 32% in 2012 to 18% in 2018. At SCQF level 5, female entrants have declined from 23% in 2014 before levelling out at 20% in 2018. It is, however, important to note that the nature of the computing courses has changed substantially since 2012, with computational thinking and programming featuring much more prominently in the new Computing Science courses. This shift in emphasis may have contributed to fewer females choosing to study the new courses.

⁵³ Engineering Science at SCQF levels 4 & 5, from its introduction in session 2013/14

⁵⁴ Includes Computing, Computing Studies, Computing Science and Information Systems

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Engineering Science is a new national qualification course, introduced in session 2013/14. While starting from a low baseline, the proportion of females studying the new courses at National 4 & 5 has increased from 7% in 2014 to just under 9% in 2018. When considering entries at National 5 level only, the proportion of females studying Engineering Science has increased from less than 8% in 2014 to just over 9% in 2018.

Figure 3: Female representation at SCQF level 6 i.e. Higher Grade in STEM in Scotland, 2012 to 2018

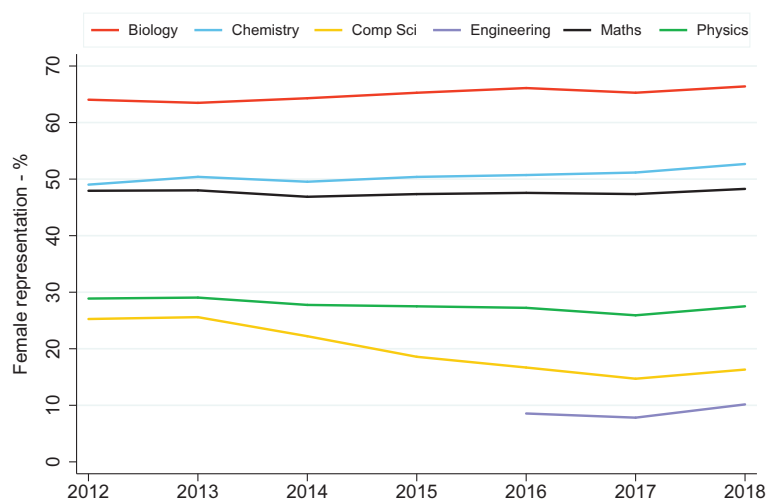


Figure 3 Source: SQA Attainment Statistics 2012 to 2018

As with the SCQF level 3-5 qualifications, for Higher qualifications, typically taken by students between the ages of 16 and 18, we see fairly constant and equal female representation for Chemistry and Mathematics, over-representation in Biology, and under-representation in Computing, Physics and Engineering Science.⁵⁵ Female representation in Physics declined from 29% in 2012 to 28% in 2018. The proportion of females studying Computing-related qualifications⁵⁶ at Higher level has declined more steeply, from 25% to 16% over the same period. It is, however, encouraging that from 2017, Figure 3 shows an upturn in the proportion of young women studying for Physics, Computing Science and Engineering Science at Higher level.

Attainment in STEM National 5 examinations

Gender stereotypes relating to intellectual ability develop at a very young age. Research indicates that stereotypes associating high-level intellectual ability with men, rather than women, are “endorsed by, and influence the interests of, children as young as 6”.⁵⁷ When asked about reasons for not choosing, or intending to choose STEM subjects, girls in Scotland were significantly more likely than boys to report that they thought they were not very good at STEM (40% vs. 17%).⁵⁸

Yet data show that girls sitting STEM subjects at National 5 level are not only more likely to pass the course than boys, but that they are also more likely to pass with a high grade (i.e., grade A).

⁵⁵ The new Engineering Science Higher course was introduced in 2015/16

⁵⁶ Includes Computing, Information Systems and Computing Science

⁵⁷ Bian, L., Leslie, S.J., Cimpian, A., Science Magazine, 27 January 2017, *Gender Stereotypes about intellectual ability emerge early and influence children's interests*

⁵⁸ Scottish Government/Ipsos MORI, March 2018, STEM and language choices in schools: *Young People in Scotland Survey 2017*.

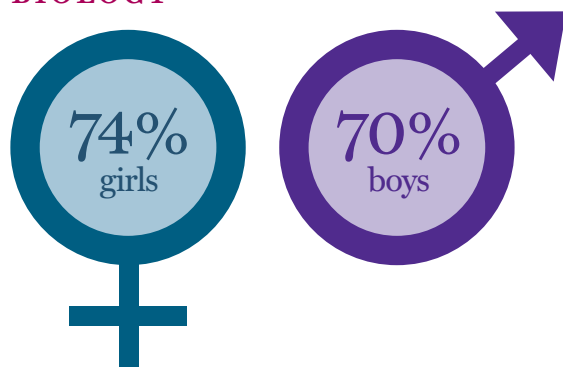


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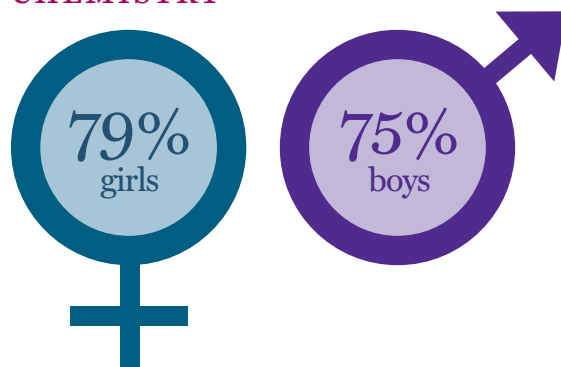
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Pass rates (Grades A-C) for boys and girls sitting National 5 examinations in 2018:

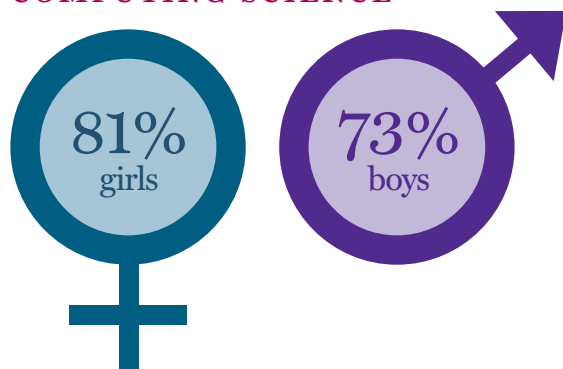
BIOLOGY



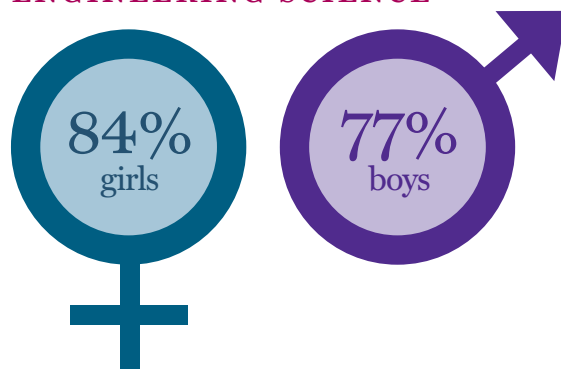
CHEMISTRY



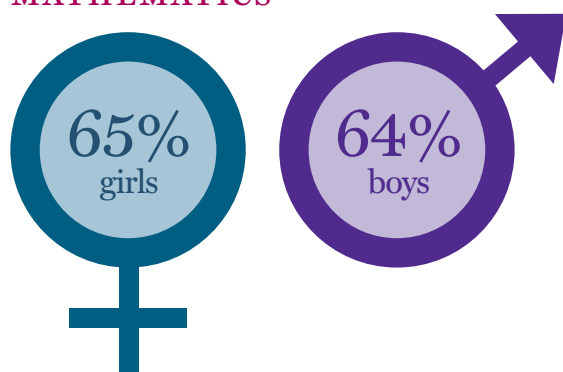
COMPUTING SCIENCE



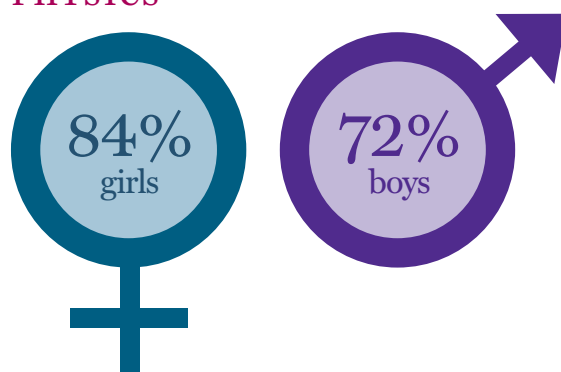
ENGINEERING SCIENCE



MATHEMATICS



PHYSICS



Source: SQA Attainment Statistics 2018

Interventions to shift norms around gender stereotypes and attitudes towards STEM must begin early in children's learning and development. There are examples of efforts being made to tackle gender inequality in early years centres and schools and to support teachers to understand and address gender issues, in relation to their own awareness and that of their pupils. Many of these initiatives have had a positive local impact. But interventions to improve gender equality and perceptions of STEM must be delivered in a coherent, collaborative and consistent manner across all early years centres and schools, with proper evaluation. Until then, Scotland will not achieve the large-scale shift in attitudes that it requires to meaningfully increase the numbers of young women choosing STEM paths.

4.1 Early years and schools: key barriers

Some of the barriers to equality in STEM in early years settings and schools relate broadly to gender equality in education settings, some to the engagement of young people of all genders with STEM, and some are specific to gender equality in STEM education.

4.1.1 Persistent gender stereotypes; unconscious (and conscious) bias

Gender stereotypes and biases abound in all parts of society. Reflecting this, awareness of gender equality issues amongst teachers, school leaders, careers advisers and parents is frequently low. Evaluation has identified the stereotypical views of key influencers, including teachers, as a major cause of different treatment of boys and girls.⁵⁹ This reinforces gendered expectations of children, both boys and girls, from a young age. In addition, gender stereotypes continue to be used across curricula, materials, language, careers advice, policies and culture in schools and early years settings.⁶⁰

Support for education professionals and other influencers to develop gender equality competence is inconsistent. Initiatives aimed at providing such support have started to lay the foundations for how this barrier might be addressed and are discussed further below. But at present, efforts are limited by the time that teachers have available to engage with the equalities agenda, as well as by schools' focus on other priorities. Where progress has been made, this is frequently due to the personal interest in the issue of one or several individuals within a school, and their drive to create change.

It is both unfortunate and unacceptable that conscious bias and misogynistic attitudes do persist in Scotland's schools. Focus group research by the Educational Institute of Scotland found that *"misogynistic attitudes towards women and girls are evident in a variety of forms within educational establishments"*,⁶¹ often widespread among the pupil population. This can manifest in behaviours from 'casual' sexist humour to sexual bullying and violence.

'Big Me' Week, Ravenswood Primary School, Cumbernauld

Ravenswood Primary School in Cumbernauld has developed a 'Big Me' week which they use as a springboard to develop a better understanding of gender issues in the school. It focuses on helping pupils reflect on their own skills and abilities and how this links with the world of work, and how gendered expectations may be limiting their understanding of this.

The Big Me week consists of several activities to challenge gendered assumptions, particularly focusing on the world of work. Learners discussed statements about gender stereotypes, drew pictures of adults in jobs with strong gendered expectations and completed an online survey with their parents around who is suitable for certain jobs. They did a 'job hunt' in the town centre where they interviewed members of the public and local business employees about their jobs and participated in a "dress as the job you want" day where staff dressed to confound stereotypes – e.g., female staff dressing as builders. Children across the school had photos taken holding signs displaying what they want to do when they grow up.

Since the launch week, staff have been weaving gender balance into their learning and teaching – for example, getting older pupils to do a persuasive writing piece on the gender pay gap and exploring women in the media in personal, social, health and economic (PSHE) lessons. In March 2018, the school celebrated International Women's Day for the first time. Pupils now understand that gender should not be a barrier to choice or success.

⁵⁹ Skills Development Scotland, March 2018, *Review of Improving Gender Balance Scotland*.

⁶⁰ For example, see Advance HE, Close the Gap, Crieff High School Reading Group, University of Dundee Athena SWAN, Equate Scotland, Heriot-Watt University, Institute of Physics, Primary Engineer, ScotlandIS, responses to *Tapping All Our Talents Review 2018* consultation

⁶¹ The Educational Institute of Scotland, May 2016, *Getting it Right for Girls*, p3

Gender Friendly Physics Programme, Lomond School, Helensburgh

At primary level, the focus of the programme was on changing perceptions of Physics amongst pupils by reframing topics to be more appealing while still covering key concepts within Engineering, Space and Pure Physics. An enrichment programme focusing on Space was introduced at secondary level. Activities included a visit to the European Space School (S1/2), rocket building within the Young Engineers challenge (S3) and helping S4 pupils to complete applications for Strathclyde Space school. S5/6 pupils completed the 'CanSat' project, which involves marketing and social media as well as building, testing and launching a small satellite, which worked well with engaging both girls and parents. Over three years, the proportion of girls taking Higher Physics increased from 14% to 44%, with girls taking on more leadership roles in STEM. Scientific achievements are celebrated across the whole school, with science awards being handed out at the same time as sporting and musical achievements.

Future plans involve integrating understanding of career paths into the school at an early age, rolling the enrichment programme into the primary school, facilitating senior pupils to lead STEM projects with younger pupils and other local schools, and focusing on other STEM subjects with a gender imbalance.

4.1.2 Low levels of teacher confidence in STEM and competing priorities

The lack of confidence in STEM among early years professionals and primary teachers has been a perennial problem in Scotland.⁶² Recent evaluation reported three key challenges to effective STEM education, as identified by school leaders and teachers: i) building teacher confidence; ii) securing appropriate resources to teach practical science; and iii) finding ways to prioritise science alongside literacy, numeracy and health and wellbeing.⁶³

As interests and attitudes towards subjects are entrenched from a young age, it is vital that teachers are supported to develop their own knowledge of STEM subjects and to deliver STEM education in an engaging, inspiring and, crucially, inclusive manner. Again, support for this is currently inconsistent and limited by STEM classroom resources, teachers' already demanding workloads and the focus demanded by other priorities.

4.1.3 (Mis)perceptions of STEM and STEM careers; science capital

Research has found that "liking science is not enough".⁶⁴ Many young people enthusiastically enjoy early science education, yet they choose not to continue with STEM as they progress. The **image of STEM** as something abstract and difficult has repeatedly been found to be a major barrier to inspiring interest in and uptake of STEM subjects.⁶⁵ While this applies to all children, it will have greater impact on girls, who are less likely to see themselves as smart or have confidence in their intellectual ability.⁶⁶ Young women were also found to have more interest in creativity and in making a positive difference through their careers, but do not consider STEM compatible with these attributes.⁶⁷

⁶² See, for example, The Robert Owen Centre for Education Change, April 2018, *Raising Aspirations in Science Education Interim Evaluation Report*; STEM Education Committee, September 2016, *STEMEC Final Report*.

⁶³ The Robert Owen Centre for Education Change, April 2018, *Raising Aspirations in Science Education Interim Evaluation Report*

⁶⁴ King's College London, November 2013, *ASPIRES: Young people's science and career aspirations*, age 10 – 14

⁶⁵ Ibid

⁶⁶ Bian, L., Leslie, S.J., Cimpian, A., Science Magazine, 27 January 2017, *Gender Stereotypes about intellectual ability emerge early and influence children's interests*

⁶⁷ PWC, 2017, *Women in Tech: time to close the gender gap*

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Young people's misperceptions of STEM are compounded by the frequent lack of sufficient **science capital** – that is, an individual's science-related knowledge, qualifications, attitudes, contacts, experiences and resources – in Scottish society today. Pupils are influenced by teachers, careers advisers, the media, peers and, often to the greatest extent, parents or carers. Research suggests that 65% of young people look to parents and families for career inspiration;⁶⁸ and it also finds that *“students from families with medium or high science capital are more likely to aspire to science and STEM-related careers and are more likely to plan to study science post-16”*.⁶⁹ Science capital is unevenly spread among societal groups and tends to be higher in middle class families⁷⁰. We have already seen that young people from the most deprived areas are less likely to choose to study a STEM subject than those from the least deprived areas.⁷¹

Misperceptions of STEM and a **lack of understanding of STEM roles** can also be reinforced within schools. By their nature, many STEM industries are innovative and fast-moving. Most teachers and careers advisers have little or no direct industry experience. It is difficult, therefore, for them to maintain up-to-date knowledge of current and emerging STEM career opportunities, paths and roles.⁷² As a result, young people are presented with an incomplete and often inaccurate or dated picture of STEM career options and are therefore hampered at a time when their decisions about the future will be most greatly influenced by the advice of adults. Efforts to overcome these misperceptions, through closer partnerships with industry and interventions by science outreach organisations, are discussed further under Section 4.3 Early years and schools: key findings 2018.

4.1.4 Managing STEM options in secondary education

Evolving education policy in Scotland is discussed in detail below. But specific issues have been identified, both in responses to this Review and more widely across the Scottish learning community, as barriers to STEM learning by young people. While these barriers affect both boys and girls, their impact on pupils' opportunities to choose STEM subjects will be an important consideration for efforts to increase the participation of young women in STEM.

First is the impact of the introduction in 2013 of the National Qualifications⁷³ on the stage at which pupils make subject choices and the breadth of subjects studied. The number of subjects, the stage at which choices are made, and subject combinations offered vary across schools in Scotland. However, this Review heard several concerns that the new structure has resulted in subject choices being made at an earlier stage and in a narrowing of the number of subjects that can be taken by pupils.⁷⁴ It is crucial that the impact of developments in the Scottish education system on the choices made by young people, including across a range of protected characteristics, such as gender, race and socioeconomic background, is monitored.

The second issue raised is access to subjects at schools, particularly at senior level. Universities Scotland, for example, noted that 78% of schools in Scotland offered Physics Advanced Higher, and only 31% offered Computing Science (CS) Advanced Higher. Again, there is significant variation across schools on their subject offering at this stage, with many school leaders pointing to the shortage of teachers specialising in some disciplines as limiting their ability to offer certain courses.

⁶⁸ Accenture, March 2018, Girls in STEM Survey

⁶⁹ King's College London, November 2013, ASPIRES: *Young people's science and career aspirations, age 10–14*, p3

⁷⁰ Ibid

⁷¹ Scottish Government/Ipsos MORI, March 2018, STEM and language choices in schools: Young People in Scotland Survey 2017.

⁷² See, for example, Scottish Power, April 2018, response to Tapping All Our Talents Review 2018 consultation; PWC, 2017, *Women in Tech: time to close the gender gap*; Accenture, March 2018, Girls in STEM Survey

⁷³ For more information, see <https://www.sqa.org.uk/sqa/58062.html>

⁷⁴ See, for example, Primary and Secondary Education Roundtable, May 2018, and Universities Scotland, April 2018, response to Tapping All Our Talents Review 2018 consultation

The Scottish Government highlights teacher shortages in some science subjects, maths and computing as areas of concern and targets for action.⁷⁵ Computing at Schools Scotland (CASS) data from 2016 show that 17% of secondary schools in Scotland did not have a specialised CS teacher.⁷⁶ At a time when the number of girls and young women studying computing science and working in the digital industry is declining, further restricting opportunities to engage with this subject only compounds the problem.

4.2 Early years and schools: developments since 2012

The Scottish education system has undergone several transformational changes in the past decade. While it is not the role of this Review to analyse and comment on the Scottish Government's broad education policy, we outline key developments below to provide context for efforts to tackle gender inequality in STEM in early years and school settings.

4.2.1 A developing context: education policy and governance

The Scottish Government's emphatic focus on education policy over recent years has been on closing the attainment gap between those born into Scotland's most deprived communities, and those born into the most advantaged communities. Early years centres and schools across the country are tasked with delivering excellent learning and teaching experiences that will improve overall levels of achievement, and do so in a way that enhances equity, focusing on literacy, numeracy and wellbeing.

This aim is supported by key wellbeing and education policy developments introduced over the past decade: *Getting It Right for Every Child* (GIRFEC) (phased in from 2008) and *Curriculum for Excellence* (CfE) (2010). But these policies also have implications for wider equality, including gender, and for STEM. They take an holistic approach to improving the wellbeing and educational outcomes for children in Scotland, using streamlined, collaborative and interdisciplinary methods to produce 'successful learners, confident individuals, responsible citizens and effective contributors'. The RSE, in conjunction with a range of stakeholders, has recognised from the outset the clear potential of interdisciplinary learning (IDL) in connecting curriculum areas and subjects, including STEM, with the wider contexts and settings in which young people learn, develop and achieve. There is substantial scope for this approach to be more widely developed within schools. IDL offers vital opportunities for teachers to engage girls in STEM by illustrating its relevance to a wide range of topics, emphasising its creative nature and considering its societal impact.⁷⁷

Developing the Young Workforce (DYW) (2014), Scotland's Strategy for Youth Employment, builds on this holistic ethos, equipping young people with hard and soft skills that align with employer demand. DYW aims to develop new work-based learning opportunities, to embed employer engagement with schools, and to enhance careers advice and deliver it from an earlier stage. STEM is identified as a specific focus, and this approach aligns with current understanding that strong partnerships between schools and industry are vital to overcoming the barriers identified above, and to tackling gender inequality. Yet progress reports suggest that there is much to be done to embed DYW and employer engagement in schools; and to address equalities issues, including gender.⁷⁸

⁷⁵ Scottish Government, October 2017, STEM Education and Training Strategy for Scotland.

⁷⁶ The Learned Societies' Group on STEM Education, April 2017, *Teacher Workforce Planning for Scotland's Schools*.

⁷⁷ Skills Development Scotland, August 2018, correspondence with the RSE.

⁷⁸ Scottish Government, January 2018, *Developing the Young Workforce: 3rd Annual Progress Report 2016-17*

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To achieve the ambitions set out in education policy, and in response to a review of Scottish school education in 2015,⁷⁹ the Scottish Government introduced two further developments that also provide relevant context for equality in STEM education: the *National Improvement Framework* (2017); and a joint approach to *reforming education governance* between the Scottish Government and CoSLA (the Convention of Scottish Local Authorities)⁸⁰ (2018). These policies seek to empower school leaders and teachers, as those closest to young people, to make decisions that will improve attainment, with enhanced support from the Scottish Government, Education Scotland, local authorities, and newly-established Regional Improvement Collaboratives⁸¹ (RICs). They set out a continuous approach, in which RICs will provide sustained focus on improvement while supporting teachers through greater professional development, collaboration between schools and peers, sharing good practice, and practical guidance.

Again, if these developments recognise the importance of equality and diversity to educational improvement, and if they incorporate enhanced opportunities for teachers to develop both gender competence and confidence in STEM, they have the potential to deliver significant positive impact on gender equality in STEM in schools.

However, the process of implementing these reforms is on-going and will rely on strong partnership working between the Scottish Government, local authorities and schools. It is essential that as policy changes are implemented across the Scottish school education system, they are properly monitored and evaluated, in order to assess their impact on pupils' wellbeing, attainment and equality.

The Scottish Government's **STEM Education and Training Strategy** (2017) explicitly recognises both STEM and gender equality in STEM as educational and economic priorities. It sets out the Scottish Government's approach to tackling challenges of how to improve STEM teaching capability in Scotland, how to inspire people to take an interest in STEM and equip them with the skills required by employers today, and how to tackle gender imbalance and other inequalities that exist across STEM education and training.

The Strategy identifies actions to address equity gaps, including new professional learning programmes on equity in STEM, embedding good practice from pilot equality projects (see below), and engaging influencers, such as parents, careers advisers and peers, to challenge stereotypes and assumptions. In addition, it supports the development of stronger connections between the education and training system, employers and emerging new regional STEM hubs. The Strategy, therefore, has significant potential to drive a step change in improving female representation in STEM, through high-quality, engaging and inclusive teaching; and through targeted interventions in partnership with industry. But it is crucial that gender equity is built into activity under all threads of the Strategy from the outset, rather than considered as a standalone element of the programme.

The STEM Education and Training Strategy is at an early stage of its ambitious five-year programme of actions. Delivery will require buy-in from a wide range of actors, not only Scottish Government and education institutions but also national agencies, enterprise agencies, local authorities, the science outreach community, employers, learned societies and the third sector.

⁷⁹ OECD, 2015, *Improving Schools in Scotland, an OECD perspective*.

⁸⁰ Scottish Government and CoSLA, June 2018, Education Bill policy ambition: a joint agreement, <https://beta.gov.scot/publications/education-bill-policy-ambition-joint-agreement/pages/3/>

⁸¹ BBC News, 3 October 2017, John Swinney: new regional education bodies to operate by end of the year <https://www.bbc.co.uk/news/uk-scotland-41491603>

4.2.2 Scottish education agencies

The greater priority given to equalities issues by the Scottish Government has been reflected by national education agencies. Each has developed its own approach to equality and diversity, with much greater attention being given to these issues in policies, practices and decision making, including decisions on funding. **Education Scotland**, for example, is “committed to developing practitioners’ understanding of equality and diversity issues”;⁸² working to embed equalities considerations in school inspection frameworks and taking a leading role in supporting the development and dissemination of gender equality interventions in schools.

The Scottish Qualification Authority (SQA) undertakes on-going research and review of its qualifications and assessments to ensure that they are as fair and accessible as possible,⁸³ while the **Scottish Funding Council (SFC)**, although primarily concerned with further and higher education, has a strategic aim of engaging with schools to tackle gender stereotypes and imbalances earlier, through a regional school engagement strategy.⁸⁴

While these are only examples of equalities activities being undertaken by national agencies, it is, once again, crucial that gender competence is widely developed and embedded within these organisations. Employees must be aware of good practice and have up-to-date understanding of institutionalised inequality and barriers to gender parity, *before* processes, policies and systems are reformed or created within the education and skills system.

4.2.3 Careers information, advice and guidance in school settings

Careers information, advice and guidance (CIAG) in schools has also been subject to extensive redesign in recent years,⁸⁵ with explicit recognition of the need for delivery of careers guidance to actively demonstrate a commitment to equality of opportunity.

Education Scotland published a **Career Education Standard (3–18) (CES)** in 2015 that sets out expectations for the delivery of CIAG in schools. Of relevance to tackling gender inequality in STEM is the commitment for every young person, and their parent/carer, to have a guidance meeting with a Skills Development Scotland (SDS) careers adviser prior to making their subject choices in S2 or S3. SDS advises that “*this intervention is aimed at challenging gender stereotypes, exploring the influences on subject and career choices and raising awareness of labour market opportunities and the routes and pathways that are available towards their career aspirations*”.⁸⁶ Finally, it sets the expectation for careers practitioners to be confident in challenging discrimination and promoting mutual respect across a range of protected characteristics, including gender.

4.2.4 Interventions in gender equality and STEM in early years, primary and secondary

There is a panoply of initiatives aimed at increasing the participation of girls and young women in STEM in Scottish schools. We consider, below, major evidence-based projects trialled across the country that have undergone, or are undergoing, comprehensive evaluation and that have potential to scale-up to the national level. Some of these focus on gender equality, while others focus on improving STEM education for all.

⁸² Education Scotland website, accessed 26 September 2018, <https://education.gov.scot/who-we-are/policies-and-information/Equality%20and%20diversity>

⁸³ SQA website, accessed 26 September 2018, <https://www.sqa.org.uk/sqa/76667.html>

⁸⁴ SFC, August 2016, *Gender Action Plan*.

⁸⁵ See, for example, Scottish Government, 2011, *Careers Information Advice and Guidance Strategy*; Skills Development Scotland, 2012, *Career Management Skills Framework*.

⁸⁶ Skills Development Scotland, August 2018, correspondence to the RSE.

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Improving Gender Balance Scotland⁸⁷ (IGBS) is a three-year project that ran in six school clusters to March 2018. Developed and led by the Institute of Physics, in partnership with Skills Development Scotland and Education Scotland, the project aimed to identify and address issues around gender imbalance in classrooms, career choice and the uptake of apprenticeships. The project took a ‘whole school’ approach to tackling gender equality, as it impacts both girls and boys, but had a focus on STEM.

Two IGBS project officers worked closely with the teachers, leaders and careers advisers in pilot early years centres and schools, and with other education and government bodies, to determine issues around gender and subject choice. The emphasis then was on developing sustainable approaches to tackling imbalances, using evidence-based interventions to promote lasting culture change.

IGBS interventions varied greatly between institutions but included support for:

- **Staff:** surveys as a starting point for developing school action plans; training on unconscious bias and gender stereotyping; assessment of and advice on inclusive teaching; creating cluster networks to share learning; supporting the delivery of STEM lessons.
- **Pupils:** observing pupils’ experiences in schools; creation of pupil focus and action groups to lead on interventions; delivering lessons on gender stereotypes, often linked to employability.
- **Careers information and guidance staff:** providing training on gender stereotyping and unconscious bias to representatives of most Skills Development Scotland regional offices; working with the University of the West of Scotland to trial approaches to embedding issues of gender stereotyping into its MSc on Career Guidance and Development.
- **Developing resources:** that allow education professionals to quickly access up to date research and best practice on gender issues, along with ideas on how to get started.

Extensive qualitative and quantitative evaluation of the IGBS pilot project has provided useful information on what works in attempts to tackle gender imbalances in schools, and what challenges remain. This learning is discussed further under ‘Key Findings’. But, importantly, the Scottish Government has made a commitment to embed the learning from IGBS in the practice of every school in Scotland by 2022⁸⁸ and Education Scotland is currently establishing an Improving Gender Balance and Equalities team to take this forward. It is crucial that on-going monitoring and evaluation are embedded as a core part of the process, allowing for future learning on how gender inequality can be effectively tackled in schools.

Raising Aspirations in Science Education (RAiSE)⁸⁹ is an on-going four-year pilot project delivered and funded by The Wood Foundation, Scottish Government and Education Scotland. With eight local authorities participating in the pilot, RAiSE aims to “*secure improvements in primary science, by developing the confidence and competence of teachers to ensure that all learners experience highly engaging and motivating learning opportunities*”.⁹⁰

⁸⁷ For more information, see https://www.iop.org/education/teacher/support/girls_physics/igb_scotland/file_70071.pdf

⁸⁸ Scottish Government, October 2017, STEM Education and Training Strategy for Scotland, p20

⁸⁹ For more information, see <https://news.gov.scot/news/raising-aspirations-in-science>

⁹⁰ University of Glasgow-Robert Owen Centre for Educational Change, April 2018, *Raising Aspirations in Science Education Interim Evaluation Report*

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Primary science development officers are appointed in each local authority area to support primary teachers through appropriate professional learning and the creation of support networks/partnerships that allow teachers and schools to mentor, collaborate and share learning.

Evaluation to date again provides useful insight into what appears to be working to enhance science education in Scottish primary schools and where the challenges still lie. While RAiSE is designed to inspire children of all genders to aspire to STEM careers, primary science development officers have received input from the IGBS project on how to drive forward this agenda in a way that promotes gender equity.

The Scottish Schools Education Research Centre (SSERC) is a key delivery partner in the RAiSE project. RAiSE complements delivery of SSERC's own **Primary Cluster Programme in Science and Technology**,⁹¹ in which school clusters identify a group of mentor-teachers in STEM who design and implement professional development for all teachers in their cluster. On-going evaluation indicates that this approach has had consistent positive impact on enhancing STEM teaching and learning in participating schools.⁹²

4.2.5 STEM outreach activity and positive action in schools

External support for engaging children and young people in STEM, both in and outwith school settings, continues to be an important feature of STEM education and training in Scotland, directly providing practical hands-on STEM experiences as well as resources and training for teachers.

Science centres and festivals across Scotland have been tasked by the Scottish Government to target young people under-represented in STEM in their outreach activity, for example by delivering at least one girls/women only event per year.⁹³ The Edinburgh International Science Festival (EISF), one of the UK's largest science outreach providers, takes its Generation Science workshops to primary schools across Scotland⁹⁴ and has made a commitment to achieving 50:50 gender parity across all its programmes, including both participants and audiences.⁹⁵

SCDI, the Scottish Council for Development and Industry, has identified engaging more girls in its Young Engineers and Science Clubs as a key area of focus;⁹⁶ while many more of the wide range of volunteer-led STEM outreach programmes have considered how to improve female representation.⁹⁷

This public and third sector outreach activity is complemented by an increasing number of female-only opportunities to engage with STEM led by colleges, universities and employers, such as visits to STEM workplaces and female role model networks. Examples include the University of Strathclyde's *Engineering the Future for Girls*, a week-long summer schools for pupils in the their third year of secondary school;⁹⁸ EDF's Pretty Curious, designed to provide teenage girls with opportunities to creatively explore STEM career opportunities;⁹⁹ and Shell's Girls Into Energy year long programme that delivers weekly lessons, workshops and field trips to girls aged 14–16 interested in exploring energy careers.¹⁰⁰

⁹¹ For more information, see <https://www.sserc.org.uk/sserc-primary-cluster-programme-findings-indicate-impact-and-success/>

⁹² The Robert Owen Centre for Educational Change, May 2018, SSERC *Primary Cluster Programme in Science and Technology: Key findings (April 2012 – March 2018)*.

⁹³ Scottish Government, October 2017, *STEM Education and Training Strategy for Scotland*

⁹⁴ For more information, see <https://www.sciencefestival.co.uk/generation-science> and EISF Annual Review 2016-17: 71% of schools visited by Generation Science were in areas ranked as the most deprived.

⁹⁵ EISF, 11 February 2018, EISF celebrates women in science, <https://www.sciencefestival.co.uk/news-article/EISF-celebrates-women-in-science>

⁹⁶ Young Engineers and Science Clubs Scotland, Annual Update 2015-16

⁹⁷ See, for example, CoderDojo, <http://www.coderdojoscotland.com/toolkit/gender-balance/>

⁹⁸ For more information, see <https://www.strath.ac.uk/engineering/outreach/engineeringthefutureforgirls/>

⁹⁹ For more information, see <https://www.edfenergy.com/prettycurious>

¹⁰⁰ For more information, see <https://www.shell.co.uk/sustainability/society/supporting-stem/girls-in-energy.html>

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However, while there are successful examples of positive action initiatives, there is continued widespread reticence among many businesses and schools to offer or engage in programmes developed exclusively to support girls into STEM. Work is needed to challenge confusion between positive action and positive discrimination; and to garner acceptance that female-specific interventions are crucial tools as part of wider, holistic approaches to overcoming entrenched under-representation in STEM. Positive action measures have an important role to play at all stages of STEM education, training and work, and are discussed in more detail in Sections 5 and 6.

All STEM outreach activities either currently do contribute to efforts to tackle gender inequality in STEM or offer the potential to do so. But this potential will only be realised if gender issues are embedded within their design (e.g., by ensuring that STEM volunteers represent a broad range of characteristics and experiences); and if they are part of a comprehensive package of sustained interventions, rather than one-off events.

4.3 Early years and schools: key findings 2018

Throughout the *Tapping All Our Talents Review 2018*, the genuine commitment and extensive efforts by government, educators and others to overcome both issues of gender inequality and low STEM uptake in schools have been evident. But data suggest that progress has been limited.

The reshaping of education policy and school governance that is being rolled out in Scotland creates the potential for equality, including addressing gender inequality, to be placed at the heart of the system. The Scottish Government's recognition of STEM as a key driver of economic growth, and the need to match workforce skills with employer demand, offer an opportunity for STEM to be recognised as a priority in the curriculum, alongside literacy, numeracy and health and wellbeing. But this potential can only be realised with explicit and emphatic attention on gender equality and STEM.

4.3.1 An embedded, whole school approach to gender equality

As recognised elsewhere in this report, a significant change in culture is required to achieve gender equality. Evidence suggests that a whole school approach is required to embed and mainstream such culture change, and to make it sustainable. This means that all strands of gender inequality should be tackled together, not limited to girls and STEM but including, for example, boys and literacy,¹⁰¹ and addressing intersectional challenges. It requires an holistic approach across the education and training system, recognising from the outset the role that gender stereotyping in nursery and pre-school plays in observable gender-based differences in school-aged children.

A key feature of the whole school approach is clear leadership on tackling gender equality from the top, with commitment and consistent engagement by senior management.¹⁰² It requires a specific champion to be identified in each school charged with responsibility for driving and coordinating this agenda.¹⁰³ But it must also secure buy in and embed equalities work at all levels of the school (teachers, pupils, senior leaders, careers advisers),¹⁰⁴ while tackling “*stereotypes and sexism within [an institution's] curriculum, language, policies and culture*”.¹⁰⁵

¹⁰¹ Skills Development Scotland, March 2018, *Review of Improving Gender Balance Scotland*

¹⁰² STEM Education Committee, September 2016, STEMEC Final Report

¹⁰³ Skills Development Scotland, March 2018, *Review of Improving Gender Balance Scotland*

¹⁰⁴ Institute of Physics, April 2018, response to *Tapping All Our Talents Review 2018* consultation

¹⁰⁵ Advance HE, April 2018, response to *Tapping All Our Talents Review 2018* consultation. See also Crieff High School Reading Group, University of Dundee Athena SWAN and ScotlandIS responses.

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Evaluation of *Improving the Gender Balance Scotland* (IGBS) and *Raising Aspirations in Science Education* (RAiSE) identifies the need to build action on gender equality and STEM into each school's existing vision, priorities and values.¹⁰⁶ These will vary between schools and regions; some may focus on fairness and equity, others on health and wellbeing or respecting rights, for example. Integrating action on gender equality and STEM into these cross-cutting themes will focus attention and improve sustainability.

As well as addressing unintentional gender stereotyping and bias, schools must ensure that they have fit-for-purpose policies and practices to address and eliminate overt misogyny, among both staff and pupils. This calls for a strong position on unacceptable behaviour, clear reporting mechanisms, effective support for victims and comprehensive action on discrimination and harassment. The Educational Institute of Scotland (EIS) recognises the need for a strong, consistent school ethos that protects gender equality and guards against stereotypes, as well as explicit exploration of misogynistic attitudes and behaviours with pupils through assemblies and subjects.¹⁰⁷

Better collection and use of gender-disaggregated and intersectional progression data will allow for the barriers present in each individual institution to be identified and discussed, and interventions designed appropriately.¹⁰⁸ It will also allow these issues and interventions to be linked to each school and/or regional improvement plan, with relevant targets and measures. There was a suggestion that there may be a case for school or regional Gender Action Plans.¹⁰⁹

The Institute of Physics has completed a successful pilot of a gender equality kitemark for secondary schools in England. The kitemark could be adopted in Scotland, for both primary and secondary schools, by combining the learning from IGBS and the pilot.¹¹⁰

4.3.2 Early and sustained interventions on gender equality and STEM

We have seen the evidence that gender stereotypes impact children and young people's beliefs from as young as six. Equally, perceptions of STEM are entrenched in early experiences. Research shows that students with low science capital who do not express STEM-related aspirations at age 10 are unlikely to develop such aspirations as they get older.¹¹¹ It is widely recognised that early interventions are required to build STEM capital, to inspire interest in STEM subjects in children of all genders from a young age, and to counter negative misperceptions of STEM.¹¹²

But equally, there is recognition that systemic change is required, moving away from single actions towards high-quality multiple, sustained interventions throughout the learner journey.¹¹³ In isolation, one-off initiatives, such as a talk from a female scientist or visits to a STEM workplace, have been shown to have little or no long-term impact.¹¹⁴ Rather, rich and meaningful understanding of the value of STEM, the range of STEM careers and the resilience to break away from gender norms, come from sustained engagement and partnerships between schools, colleges, universities and industry. Such an approach must be an integral part of the new focus on regional collaboratives across the education system.

¹⁰⁶ Institute of Physics, April 2018, response to *Tapping All Our Talents Review 2018*. See also The Robert Owen Centre for Education Change, April 2018, *Raising Aspirations in Science Education Interim Evaluation Report*

¹⁰⁷ The Educational Institute of Scotland, May 2016, *Getting it right for girls*.

¹⁰⁸ Institute of Physics, October 2015, *Opening Doors*

¹⁰⁹ The Scottish Funding Council, April 2018, response to *Tapping All Our Talents Review 2018* consultation

¹¹⁰ Institute of Physics, April 2018, response to *Tapping All Our Talents Review 2018* consultation

¹¹¹ King's College London, November 2013, *ASPIRES: Young people's science and career aspirations, age 10–14*

¹¹² Close the Gap, Equate Scotland, Primary Engineer, Scottish Science Advisory Committee, West College Scotland and individuals, April 2018, responses to *Tapping All Our Talents Review 2018* consultation.

¹¹³ Equate Scotland, Primary Engineer, Scottish Science Advisory Council, West College Scotland and individuals, April 2018, responses to *Tapping All Our Talents Review 2018* consultation.

¹¹⁴ See, for example, Skills Development Scotland, March 2018, *Review of Improving Gender Balance Scotland*

4.3.3 Overcoming gendered classrooms and low confidence: teacher professionalism in respect of gender equality and STEM

As noted previously, persistent barriers to the engagement of girls in STEM education include gender stereotyping and unconscious bias in the classroom, low levels of confidence in teaching STEM and limited access to support and resources. Teacher professionalism, that is a teacher's knowledge, skills and networks, is at the heart of the Scottish Government's approach to education improvement and governance. The National Improvement Framework approach, and particularly the Regional Improvement Collaboratives, are designed to deliver *"relentless focus on supporting teachers and staff to improve teaching and learning"*.¹¹⁵

The drive to deliver consistently high-quality support and professional development for teachers across Scotland is a timely opportunity to embed both gender equality and STEM in the education system. Many respondents providing evidence to this Review identified mandatory gender competence and unconscious bias training for all teachers and staff as a minimum starting point. The Scottish Government has committed to the development and delivery of new professional learning programmes on equity in STEM for practitioners in its STEM Education and Training Strategy. This is welcome, but it should be noted that current understanding of how to address and minimise unconscious bias is low and that research indicates that unconscious bias training is only effective if delivered as part of a comprehensive strategy.¹¹⁶

Education improvement and governance reforms also envision greater support for teachers and leaders through collaboration, peer-to-peer networks and shared learning.¹¹⁷ But if teachers are to engage in additional professional development, peer networks and partnerships with colleges, universities and industry to enhance their professionalism, including around gender equality and STEM, they must have the time and resources to do so. Unless the time and resources are secured, teachers will find it impossible to engage and implement critical elements of any national strategy on STEM engagement.

A 2016 report by the STEM Education Committee (STEMEC)¹¹⁸ identified schools operating on minimum staffing levels and insufficient dedicated professional development time for teachers as key barriers to this. It recommended that *"Scottish Government should lead the development of a coherent national strategy for building teacher and leadership social capital which allows teachers sufficient time to collaborate, undertake CLPL [professional learning] and lead delivery of the Curriculum for Excellence through consideration and restructuring of teacher numbers, workload, contact time and bureaucratic demand"*.

Such a national strategy, combined with action on increasing teacher numbers, would also ensure that senior management have the capacity to focus on strategic initiatives, such as embedding gender competence, rather than spending an increasing amount of time in the classroom to cover for shortages.

In recent years, the emphasis the Scottish Government has placed on both equality and STEM would suggest that these issues need to be prioritised in Initial Teacher Education (ITE). Yet an analysis of the content of ITE in Scotland in 2017 found that the number of hours dedicated to equality varies hugely across ITE providers and types of course.¹¹⁹ Overall, the analysis noted that *"the number of hours of dedicated contact time for equality appears to be low given the commitment in policy for excellence and equity for all children and young people"*.

¹¹⁵ Scottish Government, December 2017, National Improvement Framework and Improvement Plan 2018 p6

¹¹⁶ Equality and Human Rights Commission, March 2018, *Unconscious bias training an assessment of the evidence for effectiveness*

¹¹⁷ Scottish Government, June 2017, Education Governance: Next Steps

¹¹⁸ STEM Education Committee, September 2016, STEMEC Final Report

¹¹⁹ Scottish Government, May 2017, Initial Teacher Education: Content Analysis

The Scottish Funding Council has committed to conducting expert groups with those who lead in provision of Initial Teacher Education, Careers Advice courses and training for Early Years practitioners to discuss how that education and training can support gender competence and agree good practice.¹²⁰ This will be a useful opportunity to ensure consistent attention to gender equality issues across providers.

4.3.4 Overcoming (mis)perceptions of STEM and STEM careers: STEM capital

Frustration around the limited awareness of the relevance of STEM and the vast range of career options and pathways it encompasses was evident in responses to this Review. The travel technology company Skyscanner called for a grassroots approach to challenging thinking *“ensuring we start in school and educate parents/schools of the value of STEM and some of the biases that start there even at very early age in school. A specific example was feedback to me where girls were told if they weren’t good at ‘maths’ they couldn’t do STEM... If you can learn a language, you have the techniques and ability to learn a coding language”*.¹²¹

Respondents called for STEM to be introduced and taught in a way that emphasises its relevance to contemporary societal issues, problem-solving, creativity and a broad range of interests, to connect STEM subjects with the personal interests and values of a broader audience.¹²²

Research supports this approach, identifying that those aware of the transferability of science qualifications are more likely to study STEM beyond age 16¹²³. In a recent survey of school-age children in Ireland, Accenture found that *“changing the words we use to describe STEM subjects and careers could improve positive perceptions about them, and encourage increased participation amongst girls. Four in ten girls would be encouraged to continue with a STEM subject if it helped them to secure a wider range of life skills”*.¹²⁴

We have seen that it is often parents who have the greatest influence over the subject and career choices of their children.¹²⁵ Yet there are relatively few interventions aimed at increasing the science capital of parents and families, so that they are more likely to support their children – boys and girls – to aim for a STEM career. Calls for better engagement with parents to enhance both gender equalities awareness and science capital in response to this Review¹²⁶ are supported by research and evaluation¹²⁷. The Scottish Government’s intention to strengthen parental involvement and community engagement, for example through the National Parent Forum of Scotland and in partnership with Connect (formerly the Scottish Parent Teacher Council),¹²⁸ offers an important opportunity to develop this approach, if gender equality and STEM are recognised as key elements.

¹²⁰ The Scottish Funding Council, August 2016, *Gender Action Plan*, p33

¹²¹ Skyscanner, April 2018, correspondence with the RSE.

¹²² For example, Scottish Funding Council, Scottish Science Advisory Council, West College Scotland, University of the Highlands and Islands and individuals, April 2018, responses to *Tapping All Our Talents Review 2018* consultation

¹²³ King’s College London, November 2013, *ASPIRES: Young people’s science and career aspirations, age 10 – 14*

¹²⁴ Accenture, 2017, *Powering Economic Growth: attracting more young women into science and technology* 3.0, p6

¹²⁵ Ibid

¹²⁶ See, for example, Crieff High School Reading Group, Heriot-Watt University, West College Scotland and Universities Scotland, April 2018, responses to *Tapping All Our Talents Review 2018* consultation

¹²⁷ See, for example, King’s College London, November 2013, *ASPIRES: Young people’s science and career aspirations, age 10 – 14*; Skills Development Scotland, March 2018, *Review of Improving Gender Balance Scotland*.

¹²⁸ See, for example, Scottish Government, December 2017, *National Improvement Framework and Improvement Plan 2018*, p36

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Within schools, close partnerships with industry, professional bodies and local STEM employers will be key to offering young people a realistic picture of career options (see more on ‘Partnerships’ below). Equally, the delivery of careers information and guidance at an earlier stage allows careers advisers an opportunity to counteract gender stereotypes and negative perceptions of STEM before subject choices are made. The explicit commitment set out in the Careers Education Standard for all involved in careers education to promote “*mutual respect and equality of opportunity across genders, social background, disabilities, ethnicities, sexual orientation and religions*”¹²⁹ suggests the requirement for a proactive responsibility to do so.

4.3.5 Partnerships for supporting gender equality in STEM

Partnership working at every stage of education and training is needed to effect meaningful culture change and is a recognised success factor in equalities interventions.¹³⁰ Colleges, universities and employers can either deliver directly, or support teachers to deliver, STEM education in a confident and inspiring manner. They can help teachers and careers staff to stay abreast of fast-evolving industries and STEM careers paths; and discuss how best to present these opportunities to young people.¹³¹ Collaboration can facilitate planning of multiple, coherent and sustained interventions that expose students to a wide range of STEM roles and counteract negative perceptions. Designed with inclusivity embedded from the outset, partnerships can support the equalities agenda and showcase experiences of STEM professionals of all genders and backgrounds.

Equate Scotland, for example, commented that, “*as teachers report low levels of confidence in STEM and associated careers and the pace of change in these sectors is considerable, such partnerships [between teachers/schools and industry experts] would facilitate knowledge exchange and potentially overcome this barrier*”.¹³² PWC, in its report *Women In Tech* (2017) identified that “the technology industry could play a greater role in educating students about technology and how it’s shaping the world we live in”, as well as increasing access to technology careers.¹³³ Others called for partnerships to facilitate the greater visibility of female role models and STEM ambassadors, and more comprehensive exposure to the vast array of STEM jobs and career paths.¹³⁴

Schools in Scotland already enjoy numerous initiatives delivered in partnership with colleges, universities, employers and third sector bodies that support young people to develop a real understanding of STEM careers and aim to encourage gender equality in STEM. These range from school talks programmes, mentorship schemes and competitions to the delivery of senior phase modules by colleges and universities and access to cutting-edge STEM facilities.

However, the lack of strategic oversight of this outreach work again leads to inconsistency and overlap, with some schools successfully engaged in a range of partnerships, and others engaged in none. The Scottish Government’s STEM Education and Training Strategy acknowledges that external support for schools is a complex and confusing landscape, and that a more equitable, streamlined, quality-assured approach is needed.

¹²⁹ Education Scotland and Skills Development Scotland, September 2015, Career Education Standard (3 – 18), p7

¹³⁰ PISA, December 2016, PISA 2015 Results Volume II, *policies and practices for successful schools*

¹³¹ Scottish Power, April 2018, response to Tapping All Our Talents Review 2018 consultation

¹³² Equate Scotland, April 2018, response to Tapping All Our Talents Review 2018 consultation

¹³³ PWC, 2017, *Women in Tech: time to close the gender gap*

¹³⁴ See, for example, Crieff High School Reading Group, University of Dundee Athena SWAN, Primary Engineer, Scottish Power, Scottish Science Advisory Council and individuals, April 2018, responses to *Tapping All Our Talents Review 2018* consultation.

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The new focus on regional collaboration, through employer-led Developing the Young Workforce (DYW) groups, school–college partnerships and RICs offers a model through which support can be provided to all schools at a consistently high level, tailored to each region's needs and challenges. But impact on gender equality in STEM will only be achieved if inclusion and STEM are accepted as important facets of partnership activity.

The Scottish Funding Council recognises the value of building partnership engagement between schools, colleges and universities into the curriculum.¹³⁵ But, as noted by the University of St Andrews, consideration must also be given to how such an approach can best be supported and funded, and how outreach activity (by universities and others) can be effectively leveraged for maximum impact.¹³⁶

Early years, primary and secondary education: next steps to consider for progressing gender equality in STEM

- Ensure that gender equality and STEM are embedded as priorities in the evolving **school governance and improvement** landscape; in enhanced teacher professional learning; in the provision of careers information and guidance; and in engagement with parents, families and/or carers.
- Use developing structures, such as regional STEM hubs and Regional Improvement Collaboratives, to deliver **a consistent level of activity** on gender equality and STEM across all schools.
- Support head teachers to provide **leadership** on embedding gender equality in the culture, values, policies and practices of their schools.
- Appoint **a gender equality champion in every school** in Scotland who has responsibility for driving and coordinating gender equality mainstreaming.
- **Gender awareness training for all school staff**, with steps to enable teachers to dedicate **more time to professional development** in relation to gender awareness and competence and, where appropriate, to improving their confidence in STEM.
- Build **strong partnerships** with colleges, universities and employers to **facilitate coherent, sustained interventions** that engage girls and young women in STEM throughout their learner journeys, including **earlier, comprehensive and up-to-date careers advice**.
- Ensure that gender equality and inclusivity is **embedded in all school STEM outreach activities**.
- Explore the adoption of the Institute of Physics' **gender equality kitemark** for primary and secondary schools in Scotland.

¹³⁵ The Scottish Funding Council, April 2018, response to Tapping All Our Talents Review 2018 consultation

¹³⁶ University of St Andrews, April 2018, response to Tapping All Our Talents Review 2018 consultation

5 Gender Equality in STEM Education and Training: work-based training, further and higher education

Gender imbalances in STEM are no less prevalent in the latter half of the education and skills system: in work-based learning (notably apprenticeship programmes), colleges and universities. This is, of course, an unsurprising consequence of the subject choices made at earlier stages of the education pipeline.

Modern Apprenticeships

Overall female representation in STEM Modern Apprenticeship (MA) frameworks increased from 7% of starts in 2016/17 to 9% in 2017/18. While this proportion is still small, it is encouraging that the number of female starts in STEM MAs rose from 640 to 944, an increase of 48% in the year. The equivalent figure for males was an increase of just 4%,¹³⁷ although from a much greater number (from 9,011 to 9,385 starts).

Figure 4: Female representation in STEM-related Modern Apprenticeship Frameworks in Scotland

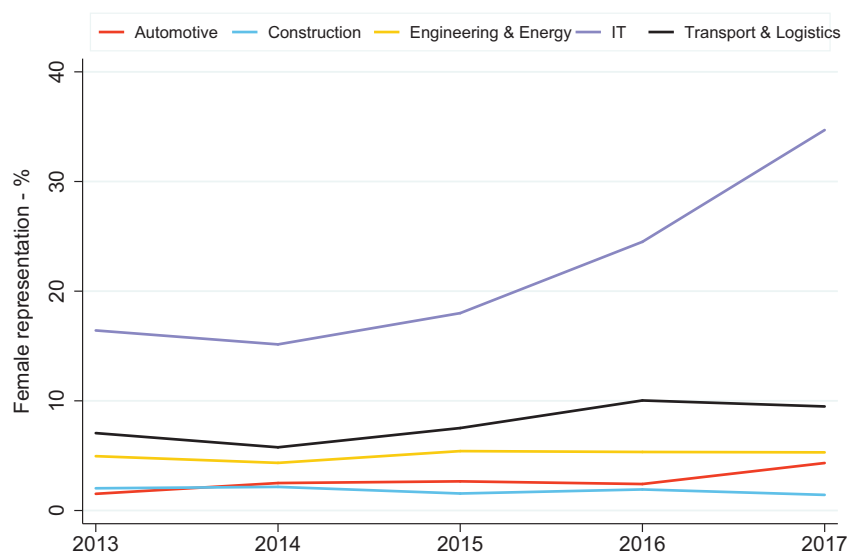


Figure 4 Source: Skills Development Scotland (SDS) Modern Apprenticeship Statistics

Figure 4 indicates a mixed picture of progress in individual MA frameworks. In some, such as Engineering and Energy, the proportion of women has remained steady over the five-year period. Construction, one of the most greatly imbalanced frameworks, has seen female representation decline from 2% to 1.4%, with only 87 women taking up positions out of over 6,000 starts in 2017/18. However, the IT & Other Services Framework stands out as a welcome positive exception, in which female representation has increased from 16% in 2013/14 to 35% in 2017/18.¹³⁸

¹³⁷ All Modern Apprenticeship data from Skills Development Scotland, June 2018, *Modern Apprenticeship Statistics 2017/18*

¹³⁸ Ibid

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It is concerning, however, that there has been a downward trend in the number of women completing apprenticeships overall, with a drop of over 1,000 between 2013–14 and 2017–18, from just under 9,000 to just under 8,000.¹³⁹ While this is not STEM-specific, it highlights the importance of monitoring not just the proportion of female starts in apprenticeship frameworks but also the proportion of completions; and of analysing the reasons why young women do not finish their apprenticeships.

Further Education

Figure 5: Female representation of entrants to STEM frameworks in Further Education in Scotland

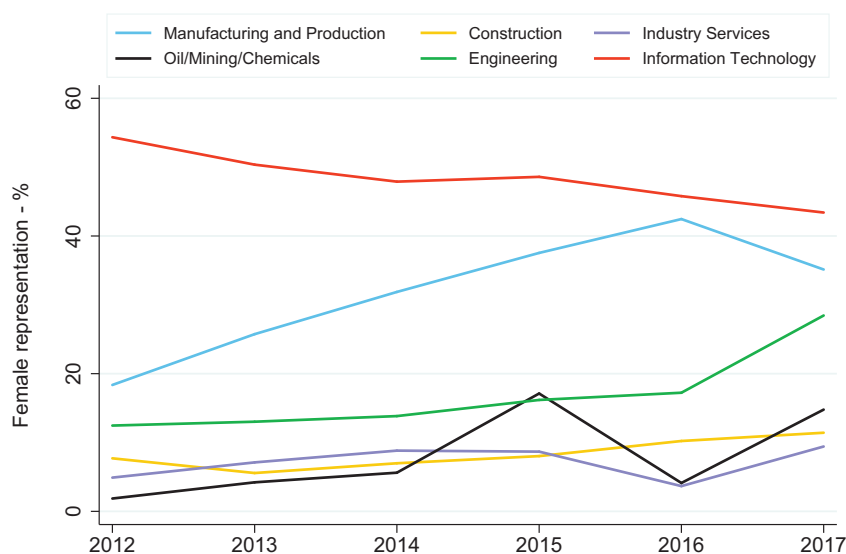


Figure 5 Source: Scottish Funding Council (SFC) Infact Database

Figure 5 indicates that female participation in broad STEM frameworks in Further Education colleges in Scotland is generally increasing slowly but steadily year on year. However, Information Technology stands out as having decreased female participation, falling from 54% to 43% over the past six years.

¹³⁹ Insider, 9 August 2018, *Number of women finishing apprenticeships falls to lowest level in seven years*, <https://www.insider.co.uk/news/apprenticeships-women-figures-fall-hepburn-13050546>

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Higher Education

Figure 6: Female representation of Scottish-domiciled Undergraduate Entrants (SDUE) in STEM-related subjects (Scotland 2012–2017)

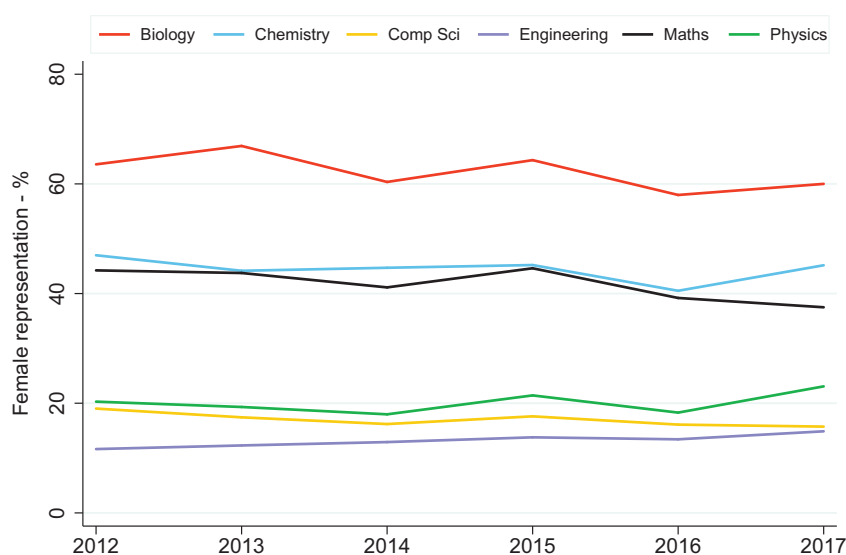


Figure 6 Source: HESA Student Statistics

Figure 7: Female representation of Scottish-domiciled Postgraduate students in STEM-related subjects (Scotland 2012–2017)

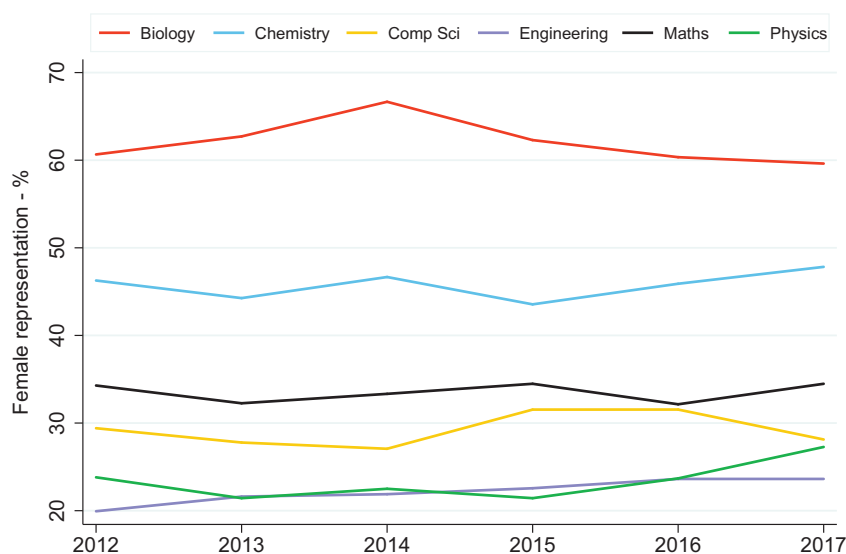


Figure 7 Source: HESA Student Statistics



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Figures 6 and 7 show the female representation of Scottish domiciled students studying core STEM subjects in Higher Education Institutions in Scotland at undergraduate (first year entrants) and postgraduate level respectively, between 2012 and 2017. Women are over-represented in Biology and under-represented in Chemistry, Computing Science, Engineering, Mathematics and Physics.

For undergraduate entrants over the six years, there has been a decline in female representation in Biology (from 64% to 60%), Chemistry (from 47% to 45%), Computing Science (from 19% to 16%) and Mathematics (from 44% to 38%). In contrast, Engineering and Physics have both seen increases in the proportion of women, although from a low base – 12% to 15% and 20% to 23%, respectively.

The picture for postgraduate students is somewhat different. Despite slight yearly fluctuations, female representation in Biology, Computing Science and Maths has remained broadly constant over time. The proportion of women studying at postgraduate level has increased somewhat in Chemistry (46% to 48%), Engineering (20% to 24%) and Physics (24% to 27%).

Although some of these figures are encouraging, they depict a picture of painfully slow progress in increasing female representation in the most severely gender-imbalanced subject groups at Higher Education (HE) level.

5.1 Work-based training, FE and HE: key barriers

Current understanding of the barriers to post-school study women face in subjects such as physics, engineering, technologies and computing science, is that they are related to both recruitment on to these paths, and to retention – successful completion – of qualifications, once started.

5.1.1 Barriers to recruitment

Many of the barriers that discourage women from applying to STEM apprenticeships, college courses or university degrees are those that shape the choices young women make in school. The early influence of gender stereotypes, perceptions of ‘men’s jobs’, the concept of STEM as ‘difficult’ and the lack of awareness of the broad range of STEM careers, combine to make STEM an unattractive choice. As many young women will have dropped STEM subjects at earlier stages of schooling, they will not, in many cases, have the requisite qualifications needed to take up higher-level education in these areas.

We have seen that stereotypes and unconscious biases continue to thrive among influencers. The legacy of teachers, careers advisers and/or parents subject to such biases continues to shape women’s choices. But this can be reinforced by stereotyping and bias among recruiters or in the recruitment process, visible, for example, in marketing materials, open days and the networks and channels through which opportunities are communicated.

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Staff training on gender equality, West Lothian College and Equate Scotland

West Lothian College has been working with Equate Scotland to train all staff in the college on unconscious bias to create a more inclusive and aware learning environment across the campus. The college has also invested in creating bespoke training with Equate Scotland specifically for teaching staff on how they can be active bystanders against sexism, can embed gender equality within their curriculums and how they can support students to be more equality aware.

The actions have included:

- Working with college staff to design and develop training
- Delivery of training
- Monitoring and evaluation of training impact
- Input into wider STEM and gender equality strategies of West Lothian College

The training has had the following impact:

94% of training participants said they felt more confident about identifying unconscious bias in the workplace, while **96%** of the participants said they felt more able to identify and reflect upon their own biases. So far, over a third of all staff (academic and support staff) across the college have been trained.

5.1.2 Barriers to retention

Where women do take up places on STEM courses in college or university, or STEM apprenticeships, a new suite of challenges emerges that can act as barriers to successful completion. Many of these challenges are those that also exist in STEM workplaces.

Studying or working in a **male-dominated environment** can create a wide range of challenges that women in STEM will need to overcome to complete their training or studies. Difficulties may arise simply from a **physical environment** that is designed for men – sizes of protective clothing available, for example, or the heights of work benches. Challenges for women arising from **workplace or course culture** can range from being subjected to daily micro-inequalities (assumptions made about their abilities, ‘casual’ sexism passed off as humour, being talked over or excluded from social activities, for example) to blatant sexism or discrimination of the type that contravenes equality legislation.

Gender-based violence and sexual harassment continue to be issues in education settings and workplaces across Scotland. These issues are discussed further in Section 6 in relation to workplaces and can directly impact young women taking up work-based training opportunities such as apprenticeships. However, they are also present in colleges and universities. Research by the National Union of Students (NUS) in 2011 found that nearly one in four women experienced unwanted sexual contact during their studies¹⁴⁰. To help address the themes identified in *Equally Safe*,¹⁴¹ a joint Scottish Government and CoSLA strategy for preventing and eradicating violence against women and girls, the University of Strathclyde, with funding from the Scottish Government, has recently developed and launched an ‘Equally Safe in Higher Education Toolkit’,¹⁴² while a new information card on how to deal with a report of gender-based violence has recently been delivered to all college and university staff in Scotland.¹⁴³

¹⁴⁰ National Union of Students, 2011, *Hidden Marks*, 2nd Edition

¹⁴¹ Scottish Government and CoSLA, April 2018, *Equally Safe: Scotland’s strategy to eradicate violence against women*

¹⁴² For more information, see <https://www.strath.ac.uk/humanities/schoolofsocialworksocialpolicy/equallysafeinhighereducation/>

¹⁴³ For more information, see <https://www.universities-scotland.ac.uk/college-university-staff-given-new-resource-help-support-anyone-experiencing-gender-based-violence/>

The extent to which studying or working in a male-dominated environment proves challenging to women in STEM will greatly depend on the culture that leaders, be they lecturers, heads of course or management, allow to flourish.

Whatever the workplace or course culture, where women find themselves in a significant minority, they will inevitably **have fewer role models, less peer support and more difficulty building or accessing networks**. All these elements support personal and professional development while enhancing access to opportunities, so their absence acts as a significant barrier to success.

5.2 Work-based training, FE and HE: developments since 2012

5.2.1 Barriers to recruitment

Post-15 pathways from school to further learning and the workplace is a policy area that has been a high priority for the Scottish Government. As discussed in relation to school education, **Developing the Young Workforce** (DYW) sets out an holistic approach to making Scotland's young people 'workplace ready', focused on engraining hard and soft workplace skills, and flexibility. The recent **15–24 Learner Journey Review**, identified broadening the range of learning and training pathways for young people as a priority.

These policies have implications for efforts to tackle gender inequality in STEM education and training in Scotland. They call for better information, advice and support on learning and careers choices, delivered at an earlier stage of schooling. They envision better alignment and flexibility between school, college and university courses, allowing learners to move more easily between these levels of study at points that suit them. And they prioritise provision of a wider range of work-based learning opportunities that are valued on a par with academic routes. Ultimately, then, they offer mechanisms through which barriers or misperceptions of STEM and lack of awareness of STEM career options could be addressed, if designed to deliver on the Scottish Government's STEM ambitions. Full advantage should be taken of the opportunity to embed gender inclusivity in this work, and to direct explicit effort towards attracting under-represented groups.

While we have previously discussed the Scottish Government's **STEM Education and Training Strategy** in relation to school education, it also has important implications for apprenticeship programmes, and for further and higher education.

Importantly, the Strategy commits to the establishment of a new regional STEM hub network, building on the central role that Scotland's colleges already play in developing local STEM activity and partnerships. Working with all school clusters by 2022, through these hubs, colleges will work to raise the profile of STEM with young people and their families, support professional development and collaboration among schools, colleges and universities, and facilitate joint curriculum planning for STEM.¹⁴⁴

In addition, each college region in Scotland is expected to develop a dynamic STEM Strategy and Action Plan to take forward the actions of the national STEM Strategy, in partnership with universities and key regional and local industries. These intentions, properly designed, will support the development of the partnerships that are greatly needed to engage all young people with STEM through inspiring learning experiences and exposure to industry; and have the potential to focus enhanced efforts on under-represented groups, including girls and women. Their impact on gender equality must be monitored and evaluated.

¹⁴⁴ Scottish Government, October 2017, *STEM Education and Training Strategy*, p33-34

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5.2.2 Expansion of apprenticeship programmes

As part of the policy developments above, the Scottish Government and Skills Development Scotland have committed to increasing provision of Modern Apprenticeships to 30,000 starts per year by 2020¹⁴⁵. In addition, they will continue to develop and expand delivery of Foundation Apprenticeships and Graduate Apprenticeships, the latter with a welcome focus on STEM.

The purpose of increasing work-based training options is to support the aim that “*all young people have high level work-based skills*”.¹⁴⁶ But while increased provision of opportunities for young people is welcome, there are implications for gender equality in STEM. There are stark imbalances in the number of young men and women taking up positions across Modern Apprenticeship (MA) frameworks, with STEM-related frameworks strongly dominated by men. In 2017/18, women accounted for only 1.4% of apprentices entering the Construction framework, which itself accounts for 22% of all MA starts, making it the largest framework by a considerable margin.¹⁴⁷

While women also dominate some MA frameworks, such as personal services and sport, health and social care, research has shown that “*men predominate in the higher-level training programmes and women in the lower-level apprenticeships, resulting in a substantial gender gap in public investment in the MA programme*”.¹⁴⁸

In line with the equality actions and targets set out in DYW, SDS published a five-year Equalities Action Plan in 2015.¹⁴⁹ This set out two gender-related objectives:

- 1 Reduce gender stereotyping and gender segregation in career choices and occupational routes chosen by young people in education.
- 2 Reduce gender segregation in MA frameworks, with a DYW Key Performance Indicator target of reducing the number of frameworks with a gender imbalance of 75:25 or worse to 60% by 2021. The most recent statistics put the figure at 72%.¹⁵⁰

Acknowledging that gender imbalances in the MA frameworks are reflective of similar imbalances in the wider workplace, the approach set out in the Equalities Action Plan focuses on partnership working with schools, intermediaries such as Equate Scotland, employers and training providers, as well as SDS staff. In addition, SDS works closely with employers through the Scottish Apprenticeship Advisory Board (SAAB), which has an established Employer Equalities Group to address under-representation and improved support and access to apprenticeships.¹⁵¹

5.2.3 The Scottish Funding Council: Gender Action Plans and Outcome Agreements

As the main public funding body for Scotland’s colleges and universities, the Scottish Funding Council (SFC), holds a powerful lever to encourage institutions to engage with the equalities agenda. In August 2016, SFC published a **Gender Action Plan**,¹⁵² with strategic ambitions for both colleges and universities to tackle all forms of gender imbalance, and an aim that no college or university course will have a gender imbalance of 75:25 or worse by 2030. This plan was drawn up through an inclusive, collaborative process with partners from a range of organisations and sectors who would also be responsible for implementing its recommendations.

¹⁴⁵ Ibid, p17

¹⁴⁶ Scottish Government, May 2018, *The 15-24 Learner Journey Review Report*, p12

¹⁴⁷ Skills Development Scotland, June 2018, *Modern Apprenticeship Statistics Full Year Report 2017/18*

¹⁴⁸ Campbell, J. and Gillespie, M., June 2017, *Gender analysis of spending in the Scottish Modern Apprenticeship Programme*

¹⁴⁹ Skills Development Scotland, November 2015, *Equalities Action Plan for Modern Apprenticeships in Scotland*

¹⁵⁰ Skills Development Scotland, June 2018, *Modern Apprenticeship Statistics Full Year Report 2017/18*

¹⁵¹ For more information, see <https://www.skillsdevelopmentscotland.co.uk/what-we-do/apprenticeships/the-scottish-apprenticeship-advisory-board/>

¹⁵² Scottish Funding Council, August 2016, *Gender Action Plan*

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A key early priority of SFC's Gender Action Plan (GAP) is to “*enhance strategic oversight of tackling gender imbalances at national, regional and institutional level*”.¹⁵³ This recognises, as we have elsewhere in this review, the need for better coordination and strategic development of actions to address gender inequality, to increase impact and consistency of effort across the Further Education (FE) and Higher Education (HE) landscape.

From the academic year 2016/17, **Outcome Agreements**¹⁵⁴ with all of Scotland's colleges and universities (i.e., what they are expected to deliver in return for public funding) have included explicit plans for tackling gender imbalances, with targets where appropriate. In addition, every college and university is required now to have its own Gender Action Plan, setting out its own proposed actions, identifying who is responsible for implementation, how the institution will build capacity for action, and how progress will be monitored.

Gender Action Plans have the potential to drive activity that addresses all the barriers identified in relation to both recruitment of young women on to STEM further and higher education courses, and retention of these students in challenging, male-dominated environments. Effective strategic oversight by the SFC offers the opportunity for consistent, coherent efforts across the further and higher education system, and consequently a step change in gender parity in STEM FE and HE courses. But this can only be realised if institutions are supported to develop high quality, meaningful plans, and held to account for their delivery. Monitoring and evaluation, and subsequent sharing of learning across the sector, will be vital to success.

5.2.4 Interventions in gender equality and STEM in further and higher education

Both the college and university sectors have been active in efforts to address gender imbalances at subject level, with much attention focused on the number of women taking STEM courses. Interventions have ranged from strengthening equality policies and staff equalities training, proactively engaging girls and young women in outreach work with schools, to auditing marketing materials for gender biases and providing enhanced mentoring support to women. The breadth and depth of activity is evident in the institutional Gender Action Plans that have been produced in the past year.

Engineering the Future for Girls, University of Strathclyde

In partnership with BP and BAM Nuttall, the University of Strathclyde is delivering a programme to engage girls in a wide range of engineering challenges that will inspire them to become the next generation of engineers. Open to all girls at Scottish schools who are studying at S3 level with any range of subject choices at National 5, the programme comprises a week-long non-residential summer school with a range of engineering-oriented challenges delivered by BP and BAM Nuttall employees and researchers from the Faculty of Engineering at the University of Strathclyde. In 2017, there were 100 fully-funded places. The objectives of the programme are to:

- Engage girls in activities that highlight their talents and enhance their self-confidence.
- Inspire more female students to become the next generation of engineers.
- Promote a wide range of career options within the different Engineering disciplines.

¹⁵³ Ibid p10

¹⁵⁴ For more information, see <http://www.sfc.ac.uk/funding/outcome-agreements/outcome-agreements.aspx>

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STEM Mentoring Network, Ayrshire College

Launched in 2016, Ayrshire Connects is a mentoring network for female STEM and construction students across the college to connect to each other, to students in other colleges and universities, to employers and women in the industry sectors they aspire to enter, and to senior pupils in secondary schools across Ayrshire.

Ayrshire Connects aims to provide: opportunities for female students to meet one another in similar situations to reduce isolation and build confidence; contact with women professionals providing role models of successful career development; and opportunities to build links with industry and potential employers.

Ayrshire College received the prestigious UK Training Provider of the Year Award at the SEMTA Skills Awards 2017 for their work inspiring future engineers, and in February 2017 they achieved the STEM Assured accreditation from the STEM Foundation. As part of the STEM Assured accreditation, the College was commended for its concerted action in planning to address gender equality challenges in STEM-related subjects through communication, engagement and influencing programmes such as the #ThisAyrshireGirlCan campaign and the mentoring network.

Confident Diversity, Edinburgh Napier University

‘Confident Diversity’ is an innovative intervention model, developed by Edinburgh Napier University, through participation in U.Lab Scotland. The Confident Diversity model looks at the issue of gender equality in STEM through a new lens: aligning the employability and equality, diversity and inclusion agendas within education. It looks to tackle occupational segregation and inequalities systematically, by taking a long-term and sustainable approach.

At its heart are two key concepts: today’s students are tomorrow’s managers and leaders who will influence equality, diversity and inclusion in their workplaces; and to be confident in managing difference we need both knowledge and enhanced personal skills.

Using the ‘Confident Diversity’ model, input is embedded throughout the curriculum and linked to professional bodies’ standards. Students gain knowledge of issues around equality and diversity (e.g., the business case, intersectionality, unconscious bias, etc.) whilst also developing skills which will support them to manage diversity (both in terms of equality strands and diversity of work approaches); communicate effectively with a range of people; and develop self-awareness and resilience.

Edinburgh Napier is currently working with the Higher Education Academy (HEA) to develop this work into a three-year project.

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Of sector-level interest is the **Attracting Diversity** programme being led by the Equality Challenge Unit (part of Advance HE)¹⁵⁵. This has involved funding 23 Scottish universities and colleges to develop tailored approaches to widening access, 21 of which focused on gender. The approach emphasised collaborative, evidence-based design of interventions and evaluating impact with measurable outcomes. With the three-year pilots ending in 2018, Advance HE will share findings from these projects and evaluation in Autumn this year. However, useful learning has emerged throughout the period¹⁵⁶ and high-level messages include:

- the need to build capacity and skills within institutions to develop evidence-based interventions, and to effectively manage their implementation and evaluation;
- the value of FE and HE institutions focusing on breaking down the barriers directly within their control;
- the need for a bolder approach to using positive action measures where there is a case to do so.

A positive action intervention that has been trialled and proven to be successful is the development of **women-only courses** in areas subject to severe occupational segregation. Women into Engineering¹⁵⁷ and Women in Construction,¹⁵⁸ developed by the City of Glasgow College, offer women an opportunity to develop experience of and confidence in these subjects without the challenges that come with studying in a male-dominated environment. Successful candidates then have an option to either mainstream into mixed gender programmes in specialist construction or engineering areas or to seek employment opportunities. There has been a significant increase in enrolments and work placements through these women-only courses and they have been well received by industry partners.

At sector level, Equate Scotland has supported the development of the **Interconnect Student Network**, now called the **Equate Student Network**,¹⁵⁹ the only network for women studying science, technology, engineering and built environment across Scotland's colleges and universities. Through this intervention, Equate Scotland works with institutions to identify student champions who are supported to develop a network that will provide peer connections and support and champion women who can feel isolated when studying in an environment dominated by men, either through force of numbers or through being shaped by them. Students who have attended network events have rated them very highly, particularly in relation to increasing their own confidence, and increasing their industry contacts and knowledge of the sector.

5.3 Work-based training, FE and HE: key findings 2018

Research undertaken by the Higher Education Academy (HEA) to provide an evidence base for SFC's Gender Action Plan mapped the gender equality activity being undertaken across the further and higher education sector.¹⁶⁰ It uncovered a wealth of actions and numerous examples of good practice across Scotland's colleges and universities.

¹⁵⁵ For more information, see <https://www.ecu.ac.uk/guidance-resources/student-recruitment-retention-attainment/student-recruitment/attracting-and-increasing-student-diversity/>

¹⁵⁶ Equality Challenge Unit, 7 July 2017, *Initial recommendations from ECU's attracting diversity project*

¹⁵⁷ For more information, see <https://www.cityofglasgowcollege.ac.uk/courses/hnc-mechanical-engineering/hnc-women-engineering-scf-level-7-2018-08-27>

¹⁵⁸ For more information, see <https://www.cityofglasgowcollege.ac.uk/courses/city-and-guilds-construction-skills/women-construction-scf-level-3-aug-2018-08-27>

¹⁵⁹ <http://www.equateScotland.org.uk/equate-scotland-student-services/network/>

¹⁶⁰ Higher Education Academy Scotland, 2016, *Whose Job Is It Anyway?*

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Whose Job is it Anyway? HEA

The HEA has analysed approaches to tackling gender imbalances at the subject level in Scotland's colleges and universities. Commissioned by the SFC, Whose Job is it Anyway? maps the approaches being utilised to tackle gender imbalances in Scotland's colleges and universities, analysing what works and offering ways forward, including a variety of examples of practice on which institutions could build.

The report identifies the following five key themes:

- 1 Infrastructure:** strong leadership; increasing staff and student capacity to tackle gender stereotypes and imbalances; resourcing gender participation initiatives, including generating and utilising research evidence; and collaboration through the development of joint projects.
- 2 Influencing the influencers:** building the capacity of educators and careers advisors; parental engagement; and educating current students; that is, the workforce and parents of both today and tomorrow.
- 3 Raising awareness and aspirations:** Outreach activities specifically targeted at young people to support education and career choices.
- 4 Encouraging applications:** Equitable recruitment and admissions processes, including the targeting of priority groups, such as under-represented genders; using counter-stereotypical marketing materials; and reshaping programmes of study to attract under-represented genders.
- 5 Supporting success:** Creating gender-inclusive environments; and enhancing the student experience. This will often include tapping in to the work of external organisations, including Equate Scotland and WISE, for their support on the experience and progression of underrepresented genders.

However, it also identified that *“currently these initiatives are the remit of a select, admittedly extremely motivated and committed, few; more is needed to engender sector-wide commitment and capacity, supporting the realisation that this work is everyone’s job”*.¹⁶¹

The requirement on all colleges and universities to develop their own Gender Action Plans is driving a step change in awareness of gender equality issues and centralisation of responsibility. But if this is to translate into a step change in impact, other essential developments must take place.

¹⁶¹ Ibid p11

5.3.1 Embedding gender equality into institutional infrastructure

First is the need to embed gender equality into institutional infrastructure. As in all sectors considered in this Review, equality can only become the norm when it is fully integrated in the policies and processes of every institution, when it is championed by senior leadership and when it is a responsibility accepted by everyone.

Learning from Attracting Diversity supports this, having found that establishing clear links between action on equality and diversity and existing institutional strategies, such as Outcome Agreements and Gender Action Plans, supports institutional buy-in. It also highlighted the need for internal partnerships to support holistic action; and warned that internal resistance to initiatives can reduce their impact, even where there is commitment and buy-in from senior leadership.

5.3.2 A partnership approach to progressing gender equality

Second is the need to take a collaborative approach to progressing gender equality. Partnerships with other colleges and universities will support sharing of knowledge and good practice. We have seen, under School Education, that partnerships between colleges, universities, schools and employers have the potential to facilitate multiple, coherent interventions that follow young women throughout their learning journeys, helping to break down the barriers they face or supporting them to overcome those challenges. Partnerships can more broadly promote STEM to all young people by directly delivering high-quality, inspiring, inclusive STEM education, and by considering the role that universities and colleges can play in enhancing professional development for teachers in this area.¹⁶² And partnerships can support smoother transitions between education stages, through co-curricula design, increased delivery of senior phase modules and up-to-date, specialised careers guidance, all in an inclusive way.

Partnerships with employers, through STEM hubs, DYW Regional Groups and work placement networks, for example, will support sharing of sector-wide gender inequality issues and best practice. It will also allow colleges and universities to mutually support employers to develop inclusive practices, ensuring that female apprentices and graduates have positive employment destination opportunities.

But collaboration within colleges and universities is also important. Equate Scotland, a key partner in delivery of interventions to improve gender equality in STEM across the sector, identified that higher education institutes and colleges too often work in siloes, not sharing often excellent practice across departments. It calls for better internal communication and efforts to ensure that all staff take responsibility for, and engage with, gender equality.¹⁶³

5.3.3 Strategic oversight of action on gender inequality in STEM in further and higher education, and in work-based training

Third, and again as we have highlighted as a priority for other sectors, is the need for more strategic oversight of action on STEM gender inequality in the education and skills system. Efforts must be coordinated, good practice scaled up and duplication of resources minimised. The SFC has taken steps towards such an approach through its Gender Action Plan, with strategic aims on mainstreaming and capacity building in relation to gender equality, greater sharing of knowledge and good practice, and the types of partnerships we discuss above. Colleges Scotland noted that national oversight of activity would be particularly important in the college sector, where education and training provision is aligned with local and regional labour market needs, rather than national skills gaps.¹⁶⁴

¹⁶² See, for example, Scottish Funding Council, August 2016, *Gender Action Plan*

¹⁶³ Equate Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation

¹⁶⁴ Colleges Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation

The SFC's Gender Action Plan was widely welcomed in responses to the 2018 Review as a key driver in the push towards gender equality. It was noted as having a role to play in setting expectations for the sector, as well as providing a mechanism to share good practice.¹⁶⁵ The Scottish Science Advisory Council called for the requirement on colleges and universities to share and act on best practice to now be the priority.¹⁶⁶ However, impact will ultimately only be achieved if colleges and universities are held accountable for effective delivery of identified actions, and achievement of targets.¹⁶⁷

The newly-formed Enterprise and Skills Strategic Board, established in late 2017 to align and coordinate the activities of Scotland's enterprise and skills agencies, has the potential to play a pivotal role. The Strategic Board's position will enable it to integrate that activity into the broader skills and enterprise landscape in Scotland. The Board has recently published its strategic plan¹⁶⁸. This makes clear the Board's intention to develop a performance framework that will include addressing gender inequality as a key component.

5.3.4 Enhanced data to inform evaluation of 'what works' in tackling gender inequality in STEM further and higher education and work-based learning

Both the Scottish Funding Council's Gender Action Plan and the Higher Education Academy's underlying research point to the importance of more focus on evidencing impact of interventions. The HEA noted the need to consider the direct outcomes of different actions, but also the longer-term, often implicit impacts on institutional culture, values and norms. We have discussed the issue of data and long-term evaluation in Section 3.3 under 'Government', and those comments apply equally here.

There are numerous sources of emerging learning on what works to enhance gender balance in STEM courses and work-based learning.

Initial learning from Attracting Diversity emphasised the importance of comprehensive qualitative and quantitative research to provide real insight into barriers to equality, and to develop effective solutions. It also underlined the need for robust evaluation frameworks to be embedded into the design of projects from the outset to facilitate meaningful learning. But a lack of capacity within project teams to carry out such research, and to develop useful evaluation frameworks, was a limiting factor in allowing impact to be measured. This suggests the need for central support to build capacity in these areas.

Attracting Diversity also identified the need to shift institutions – from senior management to course leaders – away from the view that gender imbalances at further and higher education level are inevitable consequences of societal barriers shaping choices made by young women at school. While wider influences do, of course, play a significant role in the decisions made by young women, there is much value in FE and HE institutions concentrating on the gender implications of factors that are within their control. They must be truly open to identifying and acknowledging internal barriers and be willing to make the changes needed. This may, for example, call for adjusting course titles, amending course content, reviewing entry requirements, and/or reforming the processes by which courses are marketed.

¹⁶⁵ Edinburgh Napier University, April 2018, response to *Tapping All Our Talents Review 2018* consultation

¹⁶⁶ Scottish Science Advisory Council, April 2018, response to *Tapping All Our Talents Review 2018* consultation

¹⁶⁷ See, for example, ScotlandIS, April 2018, response to *Tapping All Our Talents Review 2018* consultation

¹⁶⁸ Enterprise and Skills Strategic Board, October 2018, *Working Collaboratively for a Better Scotland*

Finally, Attracting Diversity has highlighted continued widespread reluctance among FE and HE institutions to take a more radical approach to tackling inequalities through positive action measures. This appears to be due to a combination of difficulty in securing buy-in, fear of backlash from stakeholders, and that positive action measures are seen as complicated. Where a strong, clear case has been made for a specific activity, there is a greater track record of success; so effective use of research to develop appropriate, proportionate and justifiable solutions will support the argument for positive action.

Elsewhere, Equality Challenge Funding is supporting over forty regional and action research projects that are being trialled to support under-represented groups into Modern Apprenticeships, which again offer the potential to improve understanding of ‘what works’. SFC’s commitment to enhancing the evidence base underpinning its Gender Action Plan will also be crucial for the sector, including, for example, an increased focus on intersectional data collection and analysis, and the development of a longitudinal evaluation framework for gender equality interventions.

Gender equality interventions that have been highlighted as valuable in response to this Review include peer networks; equipping college and university STEM teachers with a level of gender awareness that allows for inclusive teaching; the role of universities and colleges in developing STEM gender equality thinking in students; and the positive impact of women-only courses such as those offered by City of Glasgow College. It was noted, however, that while such positive action measures have been proven to be successful, the ultimate aim must be to work towards mainstreaming, both by minimising the barriers women face in mainstream STEM education and work; and, at least in the short term, by equipping women with the skills they need to deal with the realities of studying and working in male-dominated environments.

5.3.5 A partnership approach to progressing gender equality

We have seen that there has been a small but significant increase in the proportion of young women taking up Modern Apprenticeships in STEM, but that progress varies greatly between frameworks. Experience of those active in this area suggests that, broadly, employers and training providers are convinced of the importance of improving the gender balance, and of the benefits equality and diversity can bring. However, there are several barriers that continue to limit progress.

The key challenge of increasing the numbers of young women taking an interest in STEM careers can only be tackled by action on overcoming gender stereotypes. Through school education, we have discussed the need for employers to take a leading role in presenting a realistic picture of STEM career opportunities to young people, and in a way that engages young women.

But there are also practices directly within the control of public agencies, employers and training providers that affect the decisions young women make in relation to STEM training opportunities.

This Review heard frustrations that, while there is no longer an upper age limit to individuals taking up apprenticeship opportunities, public funding for the programme continues to be targeted at the youngest trainees. Under the majority of frameworks, the amount of funding available for 16-19-year olds taking up apprenticeships is far greater than that available for those who are 25 or older. As a result, it is often unviable for employers to offer apprenticeship opportunities to older individuals, or for those individuals to take up such positions. This impacts particularly women who are seeking workplace training opportunities after having children at a younger age.

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The current funding criteria reflect the Scottish Government's policy focus on increasing the rate of youth employment. However, as youth employment in Scotland has improved and, as the potential value of women's contributions to the Scottish economy becomes more widely recognised, a review of the funding criteria for the apprenticeship programme would be timely.

While Skills Development Scotland (SDS) hosts a central website through which employers are encouraged to advertise apprenticeship opportunities, it remains the case that many positions are filled informally, by word of mouth or through family and friend networks. In these cases, there is little opportunity for SDS to support employers to consider issues of gender bias, while informal networks tend to perpetuate traditional stereotypes. Even where apprenticeship opportunities are openly advertised, unconscious bias continues to be pervasive in the process, for example in marketing materials, the design of aptitude tests or demands for unnecessary entry qualifications.

Significant support is needed to move employers beyond recognition of the importance of gender equality towards action. Understandably, small- and micro-employers, who provide many STEM work-based training opportunities in Scotland, find it difficult to dedicate time to anything beyond their core business. Central tools and resources available to guide best practice on gender equality, while useful for employers who are keen to engage, will be of limited value to those who do not consider gender equality a pressing issue. The challenge lies in developing mechanisms through which these employers can access more hands on, tailored support, at a scale and pace that will deliver a step change in female representation in STEM work-based training, within an acceptable timescale.

The reluctance to use positive action measures continues to be an issue here. The acute gender imbalances in STEM apprenticeship frameworks provide clear justification for strong action on encouraging and supporting young women to apply. This may mean female-only pre-apprenticeship taster courses and work experience, the opportunity for young women to speak to female STEM apprentices in an informal setting, or support in preparing for interviews. SDS, for example, is working with Equate Scotland to develop a module for employers that will support them to build the skills and knowledge needed to establish effective mentoring programmes for women in STEM.¹⁶⁹ But whatever form they take, a strong case must be made that such measures are essential and proportionate to overcome the barriers that young women face to STEM training, such as male-dominated environments and exclusion from informal networks.

Finally, we note that there is much work to be done to achieve the Scottish Government's ambitions, for work-based learning and training to be given parity of esteem with further and higher education pathways. For many young people, work-based training offers valuable experience and a wealth of career opportunities. Yet it remains the case that many key influencers, including teachers, parents and peers, show preference for more traditional further and higher education pathways, and guide young people in those directions. While this affects all sectors and all young people, it serves to unnecessarily limit the breadth of pathways that young women can take into STEM careers, and therefore must be considered in efforts to tackle gender inequality in STEM.

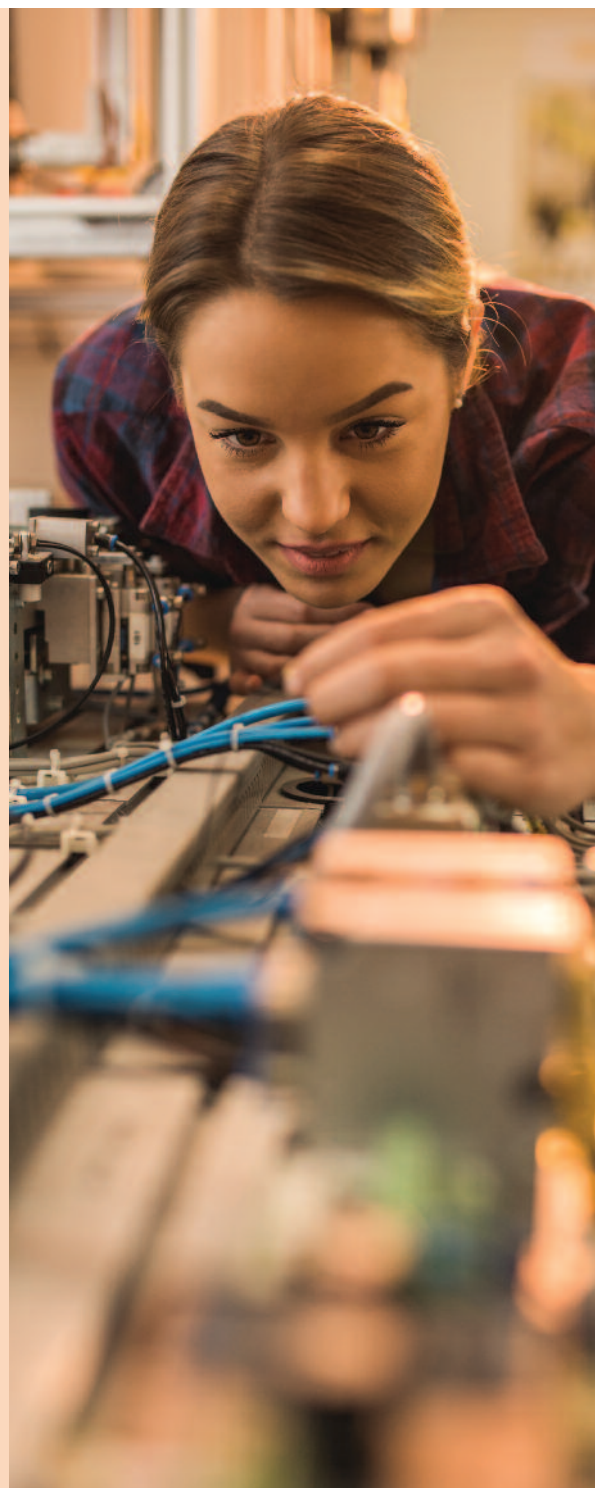
¹⁶⁹ Skills Development Scotland, August 2018, correspondence with the RSE

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Work-based training, further and higher education: next steps to consider for progressing gender equality in STEM

- Establish **clear links between action on equality and diversity and existing institutional strategies**, such as Outcome Agreements, including the setting of **clear targets** for addressing significant subject-based gender under-representation.
- Further enhance the **provision of support** available to colleges and universities seeking to adopt and embed equality-focused policies and practices, including resources and mechanisms to **build capacity for effectively managing the implementation, monitoring and evaluation** of interventions.
- Support SFC to enhance **strategic oversight of the sector**, for example through Gender Action Plans, and to **hold institutions to account** for delivery of progress against equality aims.
- Establish **the role of the Enterprise and Skills Strategic Board in integrating action** on gender equality in STEM across education, skills and enterprise sectors.
- Build **partnerships with industry** to further develop and deliver evidence-based initiatives that support female STEM students to continue into STEM careers.
- **Provide tailored support to apprenticeship and training providers**, particularly small- and micro-employers, to embed good equalities practice and progress gender equality in STEM apprenticeships.
- **Review the funding criteria of apprenticeship programmes** to consider the impact of the current policy focus on 16–19-year-olds on women of all ages being able to take up work-based training opportunities and how this can be improved.



6 Gender Equality in the STEM Workplace: business and industry

Reflecting on the substantial effort being undertaken to encourage more young women to pursue STEM careers, one respondent to this Review raised a critical question: should we be enticing women into a system which discriminates against them?

The need for urgent reform of STEM workplaces to support gender equality was the stimulus of *Tapping All Our Talents 2012*. That inquiry's purpose was to identify the barriers for highly-trained women to entering and/or remaining in STEM careers, and to progressing at equal rates to men.

Six years later, we were keen to explore whether STEM workplaces have improved in relation to gender equality.

Female representation in the STEM business and industry workforce

STEM is an important employment sector across both Scotland and the UK. The number of STEM industry jobs increased UK-wide by 17% between 2012 and 2017 and now account for approximately half of all employment. Employment in STEM industries in Scotland accounted for almost 1.2 million jobs in 2017.¹⁷⁰

UK-level figures on the **representation of women in the STEM workforce in 2017**¹⁷¹ show broadly positive trends since 2012.¹⁷² Women made up 23% of those in core STEM occupations in 2017, a notable, and welcome, increase on 13% in 2012. Progress has also been made in management roles in science, engineering and technology, in which female representation grew from 10% in 2012 to 15% in 2017. The proportion of female engineering professionals doubled, from 5.5% to 11%, and in skilled trade occupations has quadrupled from 2% to 8%. While these figures are starting from low bases, the rate of progress in increasing female representation is encouraging.

Yet in other areas, progress has remained stubbornly slow. Over the 2012–2017 period, for example, the proportion of both female ICT professionals and science professionals has increased by only 2% (for ICT 15% to 17%; for science 40% to 42%).

A key focus for *Tapping All Our Talents 2012* was the **high attrition rate of female STEM graduates from STEM industry**, in recognition of the resources invested in intensive education and training of STEM students, and the economic cost of losing valuable high-level skills and knowledge.

Across the UK, the proportion of female STEM graduates who are employed in STEM industries¹⁷³ rose from 27% in 2012 to 30% in 2017. The equivalent figures for male STEM graduates were 56% and 57% respectively.

¹⁷⁰ The figures presented are based on analysis by Dr Tanya Wilson of the Labour Force Survey (2012 – 2017).

¹⁷¹ All 2017 figures from WISE Campaign, Women in the STEM Workforce 2017, unless otherwise referenced, <https://www.wisecampaign.org.uk/statistics/women-in-stem-workforce-2017/>

¹⁷² All 2012 figures from WISE Campaign, Women in the STEM Workforce 2012, unless otherwise referenced, https://www.wisecampaign.org.uk/wp-content/uploads/2018/04/WISE_UK_Statistics_2012.pdf

¹⁷³ We define STEM industries following the respective WISE classifications, see Women in the STEM Workforce 2017.

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The aggregate UK figures, however, mask greater improvements that have been seen in Scotland over the period. Here, there were large increases in the proportion of female STEM graduates choosing jobs in the sector.¹⁷⁴ The proportion of female STEM graduates employed in STEM industry rose from 27% (2011/12) to 40% (2016/17).¹⁷⁵ In the same period, the proportion of male STEM graduates employed in STEM industry held steady, at around 65%.

These increases indicate significant, and welcome, progress in reducing the gap between the proportion of men and women graduating in STEM who decide to remain within the sector.

At **industry board level**, the 2011 *Davies Review of Women on Boards*¹⁷⁶ identified that only 12.5% of FTSE 100 corporate board members were women and recommended that FTSE 100 companies should aim for a minimum of 25% female representation by 2015. Figure 8 shows the female board representation in FTSE 100 companies across STEM industry sectors between 2011 and 2017.

Figure 8: Female representation on FTSE 100 boards across STEM industry sectors

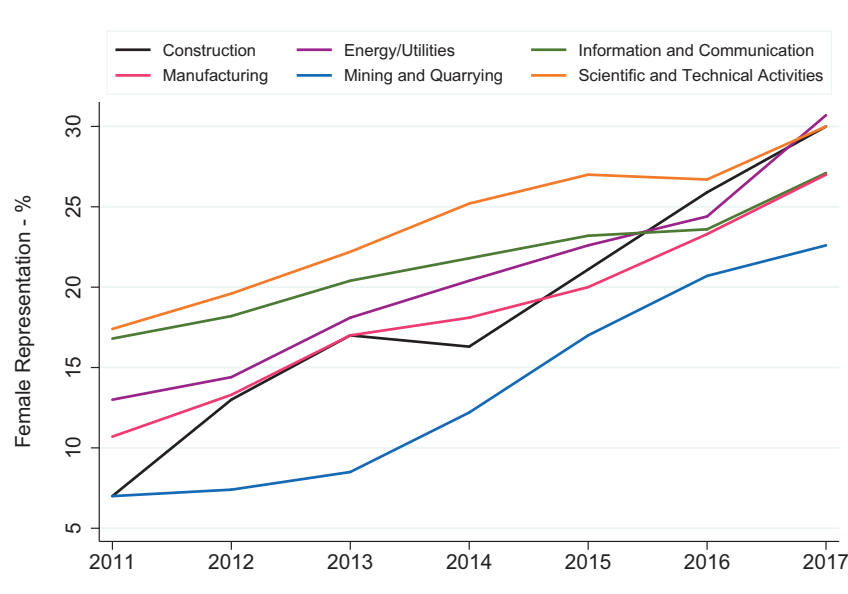


Figure 8 Source: Cranfield University, 2017, *The Female FTSE Board Report 2017*

While only one STEM sector – Scientific and Technical activities – met the 25% target by 2015, each has experienced a large uptake in female representation since 2010. If the current patterns of growth are maintained, a more recent voluntary target of 33% by 2020 should be met in all STEM FTSE 100 companies. This represents significant progress on the representation of women on corporate boards and is a positive development.

¹⁷⁴ STEM occupations are jobs that use STEM skills across all types of industry; we define STEM occupations following the respective WISE classifications, see *Women in the STEM Workforce 2017*.

¹⁷⁵ Office for National Statistics. Social Survey Division, Northern Ireland Statistics and Research Agency. Central Survey Unit, 2018, *Quarterly Labour Force Survey, 1992-2018: Secure Access*. [data collection]. 13th Edition. UK Data Service. SN: 6727, <http://doi.org/10.5255/UKDA-SN-6727-14>

¹⁷⁶ Lord Davies of Abersoch, February 2011, *Women on Boards*

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Concerns remain, however, over low female representation at **executive level**. In 2018, only 10% of executives in FTSE 100 companies were women; and only 6% across the FTSE 250.¹⁷⁷ *The Davies Review 2015 Summary Report* identified the need to ‘focus on the executive layer’ – to improve the representation of women in the Executive Committee and in most-senior leadership positions – as a priority.¹⁷⁸ However, it did not set a specific target for female representation at executive level and the figures have stalled over the last four years.

6.1 Business and industry: findings and recommendations 2012

Tapping All Our Talents 2012 identified barriers to the participation of women in STEM workplaces in four broad areas:

- 1 ***The nature and organisation of science and technology***, with academic science careers characterised by long periods of qualification, high levels of insecurity, demands for international mobility, the need to keep up with fast-paced change and few part-time employment opportunities.
- 2 ***Implicit bias*** in systems, structures, policies, processes and procedures that are influenced by preconceived views of men and women and that value some qualities or merits more than others, often to the disadvantage of women.
- 3 ***Family responsibility and career breaks***, in a STEM culture which tends to marginalise both men and women who use work–life balance policies, but which impacts more greatly on women who are generally expected to take on the majority share of caring responsibilities. This is compounded by insufficient provision of good quality, affordable childcare, particularly as many of those who work in STEM must move internationally for jobs and are therefore far from family support networks.
- 4 ***Access to research funding***, with analysis showing clear gendered differences in access to research funding and grant application behaviour, and in involvement in the types of research activities valued by assessment and promotion frameworks.¹⁷⁹

¹⁷⁷ Cranfield University, June 2018, *The Female FTSE Board Report 2018*, p14

¹⁷⁸ Lord Davies of Abersoch, October 2015, *Women on Boards Davies Review Five Year Summary* p7

¹⁷⁹ Royal Society of Edinburgh, April 2012, *Tapping All Our Talents*, p24 – 28.

Tapping All Our Talents 2012: Recommendations to Business and Industry

- Establish an **SME taskforce** to consider what specific remedies can be created for that segment of business and industry.
- Where expansive, career-enhancing roles typically come at a time when working women consider having children, businesses should develop **fast-track career paths**.
- Organisations should introduce quality **part-time employment** for men and women at all levels, with greater presumption in favour of **flexible working**.
- Employers should encourage **culture change** within the organisations, with the Managing Director or Chief Executive taking overall responsibility.
- An **Equality Audit** (including pay) should be done to create a baseline for action and a senior management champion appointed to support gender equality.
- STEM businesses and industry should improve the collection and availability of **gender disaggregated employment data**.
- Businesses should develop and embed good practice on gender neutral/inclusive **recruitment and selection** processes.
- Businesses should further invest in the **development** of their staff; criteria and processes for **promotion** should be disseminated to all staff.
- More employers should adopt **progressive policies** and practices that encourage a motivated and productive workforce, including a better work-life balance and improved maternity, paternity and family leave.
- In planning for **the development of new STEM businesses**, attention should be given to the role that women could play.
- **Industry Advisory Boards and Sector Skills Councils** should promote the benefits of diversity and gender equality in the workplace, and explore opportunities for joint work within their sector.

6.2 Business and industry: developments since 2012

6.2.1 Updating the case for change: benefits to the economy

Tapping All Our Talents 2012 set out the imperative for addressing the gender imbalance in business and industry. Since then, evidence of the economic and business case for increasing diversity has become stronger.

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In respect of impact on the economy, a 2016 report by consultancy firm McKinsey & Co identified that “bridging the gender gap in the UK has the potential to create an extra £150 billion on top of business-as-usual GDP forecasts in 2025 and could translate into 840,000 additional female employees”.¹⁸⁰ Modelling under a ‘best in UK’ scenario – in which every UK region matches the pace of the fastest-improving region in terms of gender parity over the past decade – suggests that progress on gender equality in Scotland has the potential to increase its GVA by 6% in 2025, equivalent to an additional £9 billion.¹⁸¹

6.2.2 Updating the case for change: STEM skills gaps

The McKinsey & Co report identifies extreme inequality in STEM careers in the UK as a specific area for action. The need to address this inequality is urgent. Both the UK and Scotland have ambitious aspirations for economic growth based on STEM foundations. The UK Industrial Strategy identifies four ‘Grand Challenges’¹⁸² – around artificial intelligence, low-carbon growth, mobility and meeting the needs of an ageing population – that all require the UK to have a thriving, highly innovative STEM base. The Scottish Government’s 2015 Economic Strategy identifies fostering innovation, research and development as a priority, as well as sustainable investment in STEM skills-dependent areas including infrastructure, digital connectivity and energy.¹⁸³ Scottish Enterprise’s 2018/19 Business Plan focuses on ‘realising major economic opportunities’ in high-value manufacturing, the digital economy and the low-carbon transition.¹⁸⁴

Yet, the UK Industrial Strategy itself notes that jobs in science, research, engineering and technology are expected to rise at double the rate of other occupations until at least 2023, and that most of the jobs on the Home Office’s Shortage Occupation List are in STEM-related roles or industries. A survey of employment trends in 2017 found that 79% of companies considered skills gaps to be the main threat to the UK labour market.¹⁸⁵ The Institution of Engineering and Technology’s 2017 survey of 800 UK employers in the sector found that 61% considered recruiting people with the right skills a barrier to achieving business objectives over three years.¹⁸⁶ More than 25% of businesses in Scotland are not confident that there will be enough skilled applicants to fill future demand for their high-skilled jobs.¹⁸⁷ Engineering UK estimates that the UK needs up to 185,000 engineers by 2024¹⁸⁸, while the construction sector is facing a skills crisis and the technology sector is growing faster than our current skills pool can supply.¹⁸⁹

¹⁸⁰ McKinsey & Co, September 2016, *The Power of Parity: Advancing Women’s Equality in the UK*

¹⁸¹ Ibid p16 (note figures reported are for Gross Value Added as the UK does not report Gross Domestic Product at regional level).

¹⁸² Department for Business, Energy and Industrial Strategy, November 2017, Industrial Strategy

¹⁸³ Scottish Government, March 2015, *Scotland’s Economic Strategy*

¹⁸⁴ Scottish Enterprise, 2018, Business Plan 2018/19 p8

¹⁸⁵ CBI/Pertemps, December 2017, Working Together: CBI/Pertemps Employment Trends Survey 2017

¹⁸⁶ The Institute of Engineering and Technology, December 2017, Skills and Demand in Industry 2017 Survey

¹⁸⁷ CBI/Pearson, July 2017, Education and Skills Survey 2017

¹⁸⁸ Engineering UK 2018

¹⁸⁹ Equate Scotland, June 2016, *Gender Equality is Good for Business*

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The CareerWise Programme, Equate Scotland in association with private sector partners across Scotland, including Aecom, Computer Application Services, NovaBiotics and Atkins

CareerWise provides women studying STEM subjects with paid work placement opportunities over the summer to put their learning into practice. The programme works with STEM employers to assist them in targeting talented women and increasing the number of women who would consider them a future employer of choice. The programme is a positive action measure, targeting employers with a significant under-representation of women. This programme is a way in which to engage women to have longer, successful and positive careers in the subjects they have qualified in; contributing to further economic investment and social equality.

The CareerWise project includes:

- Building a network of progressive STEM employers and building their knowledge and capacity around taking positive action measures
- Developing strong interview and CV skills for women students in STEM
- Supporting employers to develop worthwhile and skills-developing placements
- Evaluation and feedback to employers from women students

Impact:

1759 women have applied to Careerwise since it started

148 women have completed Careerwise placements

40 employers across Scotland have participated

56% of students from the first cohort are still working in STEM

Quote from Heather Bruce, 3rd Year Mechanical Engineering Student:

“What Equate Scotland has done is inspire students like me to make a difference and show girls that there is so much room for them to come into the industry. I don’t fit the stereotype of an engineer which is why I am asked so frequently why I do it. One day hopefully there will be no stereotype. Due to the support from Equate Scotland’s project I am a confident individual and I feel comfortable to speak up in a male-dominated environment.”

6.2.3 Updating the case for change: return to businesses

The benefits to businesses of enhancing equality and diversity are well established. A company that is attractive to all prospective employees is able to recruit the best talent from the widest pool of candidates. A diverse team draws upon a broad spectrum of experiences, perspectives and knowledge, enabling constructive debate, creativity and better decision making. The company has greater understanding of the needs of its diverse customer base, and enjoys reputational benefits as an employer, a product or service provider, and among potential investors. It also negates the risk of falling foul of equality legislation or, where relevant, of failing to meet equality requirements of public procurement contracts.

Another McKinsey & Co 2018 report, *Delivering through Diversity*,¹⁹⁰ provided updated insight into the financial return that businesses can achieve through improved diversity and inclusion within their own organisations. Its study of over 1,000 companies in 12 countries found a correlation between diversity at the executive level and both profitability and value creation. Companies in the top quartile for gender diversity were 21% more likely to experience above-average profitability than those in the bottom quartile. They were also 27% more likely to outperform their national industry average in terms of economic profit – a longer-term measure of a company's ability to create value exceeding its capital cost – than were the bottom quartile.

Another study of US companies between 2011 and 2016 found that those with at least three women on the board at the start of the period achieved median gains in return on equity that were 11% higher and earnings per share that were 45% higher than companies with no female directors.¹⁹¹

As recognised by Thomson Reuters' Global Head of Corporate Responsibility and Inclusion, "*Thanks to extensive data and research, and growing transparency, the case for gender equality has never been more clear*", with customers, top talent and investors all electing to engage with diverse and inclusive organisations.¹⁹²

6.2.4 Legislative and policy developments relevant to STEM workplaces

Key legislative and policy measures introduced by both the UK and Scottish Governments, discussed in detail in Section 3, have been explicitly developed to enhance gender parity and inclusion in workplaces across all sectors.

However, there is wide variation in how companies (in STEM and elsewhere) have interpreted their obligations under these measures; and the extent to which they not only comply but go further to embed them in company culture and into corporate policies.

Under **gender pay gap reporting** in 2018, for example, some UK employers published not only pay gap figures but also detailed explanations and comprehensive plans for action. However, such employers remain in the minority: analysis of 2018 reporting shows that fewer than one third published a narrative, less than one-fifth set out actions to be taken, and only 5% set targets for reducing the gap.¹⁹³ Many employers merely reported the figures, with no indication of intention to take any action to address their gender pay gap.

¹⁹⁰ McKinsey & Co., January 2018, *Delivering through Diversity*

¹⁹¹ MSCI Inc., 2016, *The Tipping Point: Women on Boards and Financial Performance*

¹⁹² Patsy Doerr, 8 March 2018, The business case for gender parity, <https://blogs.thomsonreuters.com/answeron/business-case-gender-parity/>

¹⁹³ Business, Energy and Industrial Strategy Commons Select Committee, August 2018, *Gender Pay Gap Reporting*

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As gender pay gap reporting has shown the UK to have one of the largest gaps in Europe, and with nearly 1,400 employers reporting gaps of more than 30%, the House of Commons Business, Energy and Industrial Strategy Committee suggests that businesses have an obligation not only to reflect change but to drive it, taking responsibility for the impact of their own policies, practices and culture.¹⁹⁴

Similarly, the House of Commons Women and Equalities Committee report on *Fathers and the Workplace* (March 2018), found that many employers do not support or promote **Shared Parental Leave**, and do not or cannot offer enhanced Shared Parental Leave Pay to the extent that they offer enhanced maternity pay.¹⁹⁵ Even where businesses do offer enhanced financial support for shared parental leave, the deeper issue of organisational culture that can either encourage or inhibit men from taking up such opportunities, remains a significant barrier.¹⁹⁶

As identified in the business case for change above, both the UK's **Industrial Strategy** and Scottish Government's **Economic Strategy** continue to – and, indeed, increasingly – rely upon the STEM base to provide competitive advantage in the global marketplace, and to drive high growth. Current strategies recognise the need to respond to key global issues such as the fourth industrial revolution (driven by artificial intelligence and data), climate change and an ageing population. But they also seek to position Scotland, and the UK more widely, to capitalise on the global market opportunities that these issues create, by strengthening capacity within the economy for innovation and commercialisation. The Scottish Government explicitly, and consistently throughout its economic and labour force policies, prioritises inclusive growth as the foundation for a strong Scottish economy.

Both UK and Scottish Governments recognise the challenge that current skills gaps present to achieving their economic ambitions. The UK Industrial Strategy commits to the investment in maths, digital and technical education to address skills shortages, alongside retraining schemes and a strengthened technical education system. Scotland's Economic Strategy, and the subsequent Labour Market Strategy and STEM Education and Training Strategy, set out the steps that the Scottish Government intends to take (discussed further in Sections 4 and 5 on Education). While these strategies highlight the importance of an inclusive approach to workforce development, it is too early yet to gauge the impact of skills initiatives on gender parity in STEM.

6.2.5 Scotland's Enterprise Agencies

Both Scottish Enterprise (SE) and Highlands and Island Enterprise (HIE) have recognised that gender equality – alongside equality more broadly – in the workplace is a key element of the inclusive, sustainable economic growth visualised in Scotland's Economic Strategy. As service providers to many of Scotland's high value companies, SE and HIE have pivotal roles to play in promoting the business benefits of equality and diversity and building the capacity of companies to develop good practice. As public bodies, the enterprise agencies have had a duty to set out and report on equalities outcomes under the Scottish Specific Duties of the Equality Act (2010).¹⁹⁷

The enhanced focus on equality by SE and HIE since *Tapping All Our Talents 2012* is welcome. Actions have been aimed at supporting women to develop their leadership capacity, promoting companies' understanding of diversity issues and increasing the number of women in Scotland's key sectors, many of which are STEM-related, such as Energy and Life Sciences. However, progress reports identify that efforts to monitor the impact of such activities are limited by data available from businesses on protected characteristics, including gender.

¹⁹⁴ Ibid

¹⁹⁵ Women and Equalities Commons Select Committee, 2017, *Fathers and the Workplace*

¹⁹⁶ BBC News, 12 February 2018, *Shared Parental Leave take-up may be as low as 2%*, <https://www.bbc.co.uk/news/business-43026312>

¹⁹⁷ For more information see Scottish Enterprise, 2017, *Equality Mainstreaming Report 2017* and Highlands and Islands Enterprise, 2017, *Equality Mainstreaming Report 2017*



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The purpose of the recently-established Enterprise and Skills Strategic Board is to coordinate and integrate the work of Scotland's enterprise and skills agencies to deliver inclusive growth. As indicated earlier, the Board has just published its Strategic Plan.¹⁹⁸ The Board has committed to develop a performance framework to enable it to assess whether – and at what rate – progress is being made to address gender inequality among other objectives.

6.2.6 Business and industry-led developments on gender equality in STEM

Increased understanding of the business case for diversity, rising potential for reputational damage for employers seen to be non-inclusive, and worsening skills gaps, have all contributed to changing business attitudes to gender equality. While efforts to address the issue are far from universal, there have been some sincere endeavours to tackle the barriers to gender parity in STEM industry workplaces.

There are indications that employers in Scotland are taking on board the need for staff to have **flexibility** to balance work and life commitments. The Timewise Flexible Jobs Index Scotland (2017)¹⁹⁹ states that around half of UK employees have some degree of flexibility open to them (such as working from home, or flexible start and end times). It suggests that many employers are willing to offer such options to known and trusted staff, typically as a retention tool.

Yet, the report identifies that in Scotland, less than 12% of high-quality jobs (measured as those paying a full-time equivalent – FTE – of £20,000 or more) are advertised as being flexible. This remains a significant barrier to those who would benefit from quality part-time or flexible work. In Scotland, over 128,000 people qualified to a level that indicates they should be able to earn at least £20,000 FTE want to work part-time. Most (110,000) are currently working part-time below that salary. This is not only a loss to the individual, but to the wider economy. It is a significant issue for some STEM-related roles, where the proportion of quality flexible positions advertised is low: 3% for facilities/construction roles, 5% for manufacturing; 5% for engineering and 6% for information technology.²⁰⁰

A growing number of **women's networks**, such as BCS Women, IET Women's Network, POWERful Women, Women into Construction and the Women's Engineering Society, are working to raise the profile of women in male-dominated sectors. While the nature of these networks varies, they collectively aim to attract girls and women into their sectors and support the professional development of women in the workplace, for example through networking, mentoring and training.

Increasingly, private sector STEM employers in Scotland are working with experts, such as Equate Scotland, Family Friendly Working Scotland and Close the Gap, **to better understand the barriers** that exist within their own organisations to recruiting and retaining women, and to develop actions to overcome them.²⁰¹ Many large employers, such as FanDuel and Scottish Power, have undertaken actions around normalising flexible working, inclusive marketing materials and job descriptions, enhanced maternity and shared parental leave provisions, and support for managers to ensure that policies and practices are enacted in an inclusive manner. Small and medium-sized enterprises (SMEs) have also begun to engage in the agenda, for example Senshi Digital, which has introduced a six-hour working day for all employees.

¹⁹⁸ Enterprise and Skills Strategic Board, October 2018, *Working Collaboratively for a Better Scotland*

¹⁹⁹ Timewise, September 2017, *The Flexible Jobs Index Scotland*

²⁰⁰ Ibid p10

²⁰¹ For more information, see case studies at <https://www.familyfriendlyworkingscotland.org.uk/what-we-offer-case-studies/>

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While such policies and practices encourage diversity and support women to remain in the workplace, most benefit all employees with caring responsibilities and outside commitments. Case studies and best practice learning emerging from these initiatives provide a useful resource for peer organisations that are considering how to address diversity issues.

Equate Scotland also works closely with STEM employers in Scotland on projects that aim to **embed best practice on gender equality** in industry, and to support women in STEM careers.²⁰² Working in partnership with educators and employers, it has produced best practice guides for technology, engineering and construction employers. Equate Scotland works with industry to develop returnships for women with STEM industry experience who have been out of the workplace for more than two years. And it is a valuable provider of consultancy support and training on gender issues to industry employers and staff.

The most common initiatives introduced across STEM industries include the development of women's networks; mentoring or sponsorship schemes; outreach activity directly targeting girls and young women (mainly in schools/college/universities); and equality and diversity training and unconscious bias training for staff.

To date, however, there has been limited use of positive action measures by industry that specifically encourage and support women to engage with the STEM industry, either from the outset of their careers or when returning from a career break. Although such measures can be legally justified where there is clear evidence of severe under-representation, bolder actions such as female-only placements, trainee opportunities or changes to recruitment, are significantly less likely to be pursued, out of misunderstanding of what positive action is and fear of legal action. However, as shown earlier, positive action measures have proven to be an effective and proportional means of addressing gender imbalance in STEM areas.

6.2.7 Female entrepreneurship in STEM

Tapping All Our Talents 2012 set out the case for strong female entrepreneurship in STEM, noting that *‘female entrepreneurs are more likely than their male counterparts to be providing a product new to the market, more likely to be using technology in their products or services and more likely to be offering a product or service that has been developed in the last year’*.²⁰³

There have been a range of initiatives at Scottish and UK levels in recent years that aim to support and improve the numbers of female entrepreneurs overall, including the Scottish Framework and Action Plan for Women's Enterprise (2017),²⁰⁴ Innovate UK's Women in Innovation campaign,²⁰⁵ and, most recently, the UK Government's commitment to its first 'serious review' of the evidence that women business founders are restricted in their access to funding, to report later in 2018.²⁰⁶

²⁰² For more information, see <https://equatescotland.org.uk/>

²⁰³ Royal Society of Edinburgh, April 2012, *Tapping All Our Talents* p19

²⁰⁴ For more information, see <https://www.gov.scot/Resource/0052/00524024.pdf>

²⁰⁵ For more information, see <https://www.gov.uk/government/collections/innovate-uk-diversity-and-inclusion#women-in-innovation:-campaign>

²⁰⁶ The Telegraph, 8 March 2018, *Government launches review into women being held back in business*, <https://www.telegraph.co.uk/women/business/government-launches-review-women-held-back-business/>

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Progress, however, has been slow. The proportion of women among those who are self-employed in STEM fields was 14% in 2017, an increase from 11% in 2013.²⁰⁷ Innovate UK estimates that the lack of women in sciences and science entrepreneurship represents a loss of around £2 billion to the British economy every year.²⁰⁸ The global share of women among inventors listed in patent applications in the UK increased from 10% (1996–2000) to 12% (2011–2015). In the same periods, patent applications that include at least one woman among inventors increased from 15% to 18%.²⁰⁹

Yet there are concerns that even such slow progress may be in decline. Across all sectors, UK companies with at least one female founder raised less investment in 2017 than in 2016, the first drop recorded since reporting began in 2011. At the same time, the total amount of funding raised by entrepreneurs in the UK almost doubled, meaning that the proportion of all funding invested in businesses with at least one female founder fell from 15% in 2016 to 8.5% in 2017.²¹⁰ Unconscious biases continue to present a significant challenge, when, in 2017, only 8% of partners in the UK's top 100 venture firms were women.²¹¹

6.3 Business and industry: key findings 2018

The data show that there has been some encouraging progress towards improved female representation in the STEM workplace by some measures, for example on boards and in the number of female STEM graduates staying in the sector in Scotland. Yet by other indicators, progress remains undeniably slow. The business case for diversity is clear, and the need for a radical approach to overcoming skills gaps irrefutable.

At the same time, workplaces are undergoing a transformation, as technology disrupts standard working practices, and as employees seek out diversity and flexibility. A Deloitte survey of over 10,000 millennials in 36 countries found that culture and flexibility were two of their top three priorities when considering an employer, and that 69% would stay for over five years in a diverse organisation, versus 27% who would remain in an organisation that was not diverse.²¹² Few organisations have yet embraced the changes these developments bring, but the pressure to do so will only intensify. Ensuring that gender equality is considered as a core element of redesigned workplace practices will deliver benefits to women and to the whole workforce.

Some employers point to the relatively few numbers of young women entering STEM as a problem beyond their control. We have discussed the need for businesses to work closely with the education system to improve the perception of STEM and understanding of STEM opportunities. This is vital to encouraging more young people to consider entering STEM careers and should be explicitly designed to be inclusive.

But there is, of course, much that employers can and must do to remove the obstacles faced by women currently in the workplace. While the proportion of women entering the workforce in certain STEM sectors is poor, the proportion progressing to the highest levels of leadership is significantly worse; and figures show the gender pay gap remains an entrenched feature of the UK economy. Industry needs to step up its efforts to address these issues. McKinsey and Co identified two key factors that will accelerate the pace of change: leadership from the top and tracking and accountability²¹³. The findings of the *Tapping All Our Talents Review 2018* reflect this, while calling on businesses and industry bodies to be bolder in addressing gender equality.

²⁰⁷ The Financial Times, 23 October 2017, *Science start-ups struggle to bridge the gender gap*
<https://www.ft.com/content/80b49f7a-76b5-11e7-90c0-90a9d1bc9691>

²⁰⁸ Ibid

²⁰⁹ Elsevier, June 2017, *Gender in the Global Research Landscape Report 2017*

²¹⁰ Forbes, 20 March 2018, *Funding for female entrepreneurs in the UK takes a tumble*,
<https://www.forbes.com/sites/davidprosser/2018/03/20/funding-for-female-entrepreneurs-in-the-uk-takes-a-tumble/#6644ae1c6a93>

²¹¹ TechCrunch, October 2017, *Crunchbase Women in Venture*, 2017 Update

²¹² Deloitte, January 2018, *Millennial Survey 2018*

²¹³ McKinsey & Co., October 2017, *Women Matter: time to accelerate*

6.3.1 Leadership from the top: placing gender equality at the heart of business

A first step towards gaining traction is for industry leaders of all genders, from business leaders and investors to professional bodies and skills councils, to be loudly and consistently vocal about the benefits of gender equality.

Delivering real organisational culture change is not an easy task, but it is necessary in order to address the gender balance in STEM workplaces. We have identified elsewhere in this Report that embedding equality in organisational culture requires both strong leadership at senior level and buy-in from all involved in the organisation.

There is a clear consensus that this holds true within the business sector. Culture change must be driven by visible and meaningful commitment from senior leadership. In small and micro enterprises, business leaders directly shape the working environment and ethos for all staff, setting the tone that defines the approach to equality and diversity. In medium, large and/or hierarchical organisations, corporate policies and practices are applied as interpreted by layers of line managers with their own interests and experiences. It is only when strong, sustained emphasis is placed on equality at the very top, and consistently reflected in performance measures and values that are rewarded through, for example, appraisal and promotion processes, that all employees will contribute to real change. As Equate Scotland commented *“Equality and diversity needs to become the responsibility of all, not simply of someone in HR... strategies need to ask something of everyone in an organisation and be part of appraisals and promotions to embed the importance of equality and diversity”*.²¹⁴

6.3.2 Data: tracking and accountability

Respondents to this Review were clear in their call for businesses to be proactive in identifying the challenges within their own organisations; to make public their commitment to tackling problem areas; and to be transparent in monitoring their progress towards gender equality.²¹⁵

There is little consistency across industry on the collection and publication of gender-disaggregated data on participation, progression and retention. And there is a paucity of intersectional data that reflects the experiences of people with a combination of protected characteristics, both in information collected and published by industry; and in labour market statistics gathered by the UK and Scottish Governments.

Organisations have a responsibility to evaluate what is happening internally and to develop holistic strategies to address issues. But it is only when clear targets, actions and deadlines are made public, together with regular, published reports on progress, that businesses can be held to account. We have seen that customers, employees and investors increasingly seek to engage with diverse organisations. Transparency on these issues, then, can bring significant reputational rewards for a business, even where it is starting from a low equality base, if it demonstrates that it is making sincere efforts to improve.

Gender pay gap reporting is a step in the right direction towards organisational transparency and accountability in respect of gender pay equality. But it remains to be seen, when the second round of figures are made public in 2019, whether the legislation and subsequent public attention are enough to drive improvements in visibility of, and action to address, the gender pay gap.

²¹⁴ Equate Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation

²¹⁵ See, for example, Close the Gap, Equate Scotland, Edinburgh Napier University, University of St. Andrews, West College Scotland and individuals, April 2018, responses to *Tapping All Our Talents Review 2018* consultation

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Research suggests that even where data on female representation at different levels are tracked internally, few businesses integrate action on gender equality into performance evaluation of senior managers.²¹⁶ Too often, gender equality is seen as an issue for women, or for the HR department. To encourage widespread buy-in, it is essential that specific actions and targets designed to enhance gender equality are embedded within the appraisals process. All managers and employees must understand what is expected from them and be held accountable on an on-going basis.

6.3.3 Policies and practices to address gender inequality in the STEM workplace

The barriers to gender equality will vary between organisations, and solutions to those challenges must be tailored accordingly. There is support available to businesses that wish to audit their current situation but do not have the internal expertise to do so. As well as private consultants, third sector bodies are important resources for driving gender equality in Scottish workplaces and must continue to be supported. Equally, it is crucial that employers engage their staff, of all genders, in identifying the challenges they face and in both developing and evaluating appropriate initiatives.

Fundamentally, however, the key barriers as understood in 2012 remain the same: the nature of STEM careers, characterised by fast-paced change and few quality part-time positions; pervasive implicit and sometimes explicit bias; and the impact of family responsibilities and career breaks that fall disproportionately on women.

Encouragingly, measures to address these barriers are becoming increasingly common in Scottish workplaces. That we have not seen a step change in the rate of progress towards equality is in part a reflection of the restricted impact that reformed policies and practices can have if they are not supported by strong leadership and underlying culture change. But the lack of sector-wide progress on gender equality is also a result of too few businesses engaging in the agenda, inconsistent quality of initiatives where they are introduced, and insufficient attention to evaluation.

A range of key policies and practices were highlighted in evidence.

The **gender pay gap** is a key measure of progress towards gender equality in the workplace and must be an urgent focus for action if equality is to be achieved. In many cases, the gender pay gap arises from cross-sector occupational segregation, in which men are funnelled into higher-paying industries, and from internal segregation, with more men occupying senior roles. Policies such as those set out below support the development of a culture within STEM businesses that makes them a more attractive workplace option; and break down the barriers that women face throughout their career progression. Employers who set out clear targets for reducing their gender pay gap are more likely to commit resources to developing the appropriate range of interventions required to meet their goals.

The availability of high-quality **part-time and flexible roles** as standard was highlighted as the development that would have the greatest impact on gender equality in the workplace.²¹⁷ While such flexibility is becoming more widespread among large corporations, Scotland's STEM industry has a high prevalence of SMEs which, although invested in the wellbeing of their staff, often find it more difficult to make flexible and part-time working successful.²¹⁸

²¹⁶ McKinsey & Co, October 2017, *Women in the Workplace 2017*

²¹⁷ Close the Gap, ScotlandIS, University of St Andrews, University of Strathclyde, University of the Highlands and Islands, West College Scotland and individuals, April 2018, responses to Tapping All Our Talents Review 2018 consultation

²¹⁸ Business and Industry Roundtable

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However, even where flexible and part-time working, or other family-friendly policies such as enhanced maternity and shared parental leave offers, are available, those who take up these opportunities (women, disproportionately) frequently continue to face career penalties. Part-time work is considered less valuable: part-time employees experience a significant hourly pay penalty (on top of loss of income due to working fewer hours).²¹⁹ Businesses continue to value and reward presenteeism and availability outside core working hours, while pervasive cultural norms (in organisations and in society) stigmatises men taking on more caring responsibilities.

The offer of high-quality flexible and part-time roles, therefore, must be supported by a rethink of merit and the value placed on more flexible contributions to the organisation. Policies and processes should ensure that career breaks and flexible working patterns do not negatively impact development and progression opportunities. Senior management can remove stigma and lead culture change by acting as role models, normalising the uptake (by women and men) of progressive policies through their own behaviour, for example male leaders demonstrating they take on a greater share of responsibilities at home.

Unconscious bias training has become significantly more widespread since 2012, and there are calls for such training to be mandatory for all managers and staff involved in recruitment and promotion processes.

Unconscious bias sessions are a useful starting point for raising awareness of the implicit biases that influence thoughts and behaviours. However, a recent review of the evidence on such training cautions against the belief that it will lead to long-term change.²²⁰ It advises that *“If the aim of UBT [unconscious bias training] is to have an impact on company practice and employee behaviour to foster inclusive cultures... [it] should be treated as just one part of a comprehensive strategy for achieving organisation-wide change”*.²²¹

There is a need to move away from standalone unconscious bias training to a comprehensive and on-going programme to develop gender competence among employees. Staff should be equipped to identify and challenge biases that exist in their working environment; for example, in corporate procedures or workplace norms. It is for this reason that some training providers, such as Equate Scotland, include practical unconscious bias organisational planning as part of their training and check in with organisations after training has taken place to review if organisations have taken any action as a result.

Recruitment and promotion opportunities were particularly highlighted as points along the career path at which women are held back, with calls for employers to audit their policies and processes and embed equalities best practice.²²² Innovative approaches are required to overcome the biases inherent both in the people involved in recruitment and progression decisions, and in the processes themselves.

For some years now, it has been understood that the use of language associated with gendered stereotypes in job descriptions contributes to gender inequality in the workplace.²²³ There are numerous sources of advice on gender-neutral design and wording of job descriptions and adverts.

In addition, consideration should be given to how the company presents itself, ensuring that marketing materials promote an inclusive and diverse image. Equate Scotland has recently launched *Careerhub*, the only site in Scotland dedicated to specifically advertising STEM jobs to women, with language reviews to check for gender bias.

²¹⁹ This penalty is greatest for those with qualifications – a drop of some 28% for those qualified to SCQF level 6-7; Timewise Flexible Jobs Index Scotland

²²⁰ Equality and Human Rights Commission, March 2018, *Unconscious bias training an assessment of the evidence for effectiveness*

²²¹ Ibid, p8

²²² Close the Gap, University of St Andrews and West College Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation

²²³ See, for example, Gaucher, D., Friesen, J., and Kay, A. C., 2011, *Evidence That Gendered Wording in Job Advertisements Exists and Sustains Gender Inequality*

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Equate Careerhub

Recently launched, Equate Careerhub is the only dedicated website in Scotland focused on the recruitment of women to science, engineering, technology and built environment careers. The website provides the latest job opportunities across these vital sectors and supports progressive employers to reach out to women, encouraging them to apply for roles which are traditionally male dominated. The website acts as a first step for many employers to pursue further positive action measures and assists them to review their recruitment processes. The aim of the initiative is to radically increase the number of women in STEM roles and encourage employers to consider their recruitment processes and implement more flexible, fairly paid and quality part-time work.

Careerhub actions include:

- Developing a network of employers who are keen to recruit women in new and inclusive ways
- Providing job advertising space on Equate Scotland's dedicated site and social media
- Reviewing job adverts and descriptions for gender biased language and imagery
- Encouraging employers to offer flexible or part-time roles
- Training employers in using language more inclusively and taking proportionate positive action measures

<https://equatecareerhub.org.uk/>

Further, employers should support staff involved in these processes to develop their own gender competence, to minimise their own biases and to better assess applications with awareness of how gender influences style of the applicant (with women less likely to take individual ownership of achievements, for example); and of referees, who may unconsciously focus on different traits for different sexes. Promotion criteria and processes must be transparent to provide assurance of fairness. Equally, employers must ensure that the metrics used to evaluate an individual's experience and achievements do not undervalue contributions made on a part-time or flexible basis; or discriminate against those who have taken a career break.

All of these measures contribute to an **inclusive environment** in the workplace. The tone of the workplace environment is determined in large part by the attitudes and approaches of senior management, and by the policies and procedures that are in place to support inclusivity. A consistently low tolerance of unacceptable behaviour, effective reporting mechanisms, well-designed support for victims and comprehensive action on discrimination or harassment, will set clear standards for all employees and reassure women that their workplace is safe and supportive.

It is essential, however, that such policies and practices are followed. The prevalence of **gender-based violence and sexual harassment** in workplaces in Scotland is difficult to measure in light of low levels of reporting, but research has shown that it continues to be rife. A 2016 UK survey by the TUC found that over half of women had experienced sexual harassment in the workplace, and four in five did not report it to their employer for fear of negative consequences.²²⁴ Engender highlighted that “*women’s attachment to the labour market, or to an employability programme, may be affected by an experience of gender-based violence*”.²²⁵ Briefing from the Scottish Women’s Rights Centre emphasises that many workplaces have well-developed policies and procedures in place for reporting and handling sexual harassment complaints, but that women’s experience is that these are frequently not followed, with priority given instead to protecting the organisation and, by extension, the perpetrator, resulting in further trauma for the victim.²²⁶

6.3.4 Positive action measures to support gender equality in STEM business and industry workplaces

The Equality Act 2010 extended the scope of permitted positive action measures, i.e., voluntary measures that specifically target groups that can be reasonably considered disadvantaged, in order to reduce under-representation and meet particular needs.²²⁷ Yet employers appear reluctant to use such measures when addressing gender inequality, for fear of misinterpreting legalities (and straying into the realm of positive discrimination, which remains unlawful), creating divisions among the workforce and/or perceptions of undermining meritocratic systems.

We have seen examples of such measures developed in Scotland’s college sector and numerous industry initiatives designed specifically to interest girls in studying STEM in school. Elsewhere in Europe, the most prevalent and well-developed positive action measures are those that address the under-representation of women in the labour market.²²⁸ Examples include the L’Oreal Finland for Women in Science Fellowship; and special training for women for positions that are currently dominated by men in Sweden.²²⁹

Many of those involved in the drive towards gender parity suggest that employers in Scotland, and the UK, must be more courageous in their use of positive action measures, if we are to achieve a step change in the representation of women in STEM workplaces. This may include the development of returnship programmes as standard practice, the introduction of placements solely for undergraduate women to encourage them to remain in the sector, and investment in outreach and engagement with women and girls.

Positive action measures must be developed as proportional responses to a strong evidence base for under-representation. To minimise the resistance to such measures, businesses must be clear that they do not amount to preferential treatment, but rather provide equality of opportunity and deliver universal benefits to both the business and to wider society.

²²⁴ The TUC, 2016, *Still Just a Bit of Banter?*

²²⁵ Engender, June 2016, Parliamentary briefing: *Scottish Government debate on gender and the workplace*

²²⁶ Scottish Women’s Rights Centre, February 2018, Evidence to the Scottish Parliament’s Standards, Procedures and Public Appointments Committee

²²⁷ For more information, see

<https://www.equalityhumanrights.com/en/legal-work-scotland/legal-work-scotland/scottish-legal-articles/positive-action-%E2%80%93-your-opportunity>

²²⁸ Equinet European Network of Equality Bodies, February 2015, Positive Action Measures: The Experience of Equality Bodies

²²⁹ Ibid p 29-33

6.3.5 Gender equality in small and medium enterprises

SMEs in Scotland account for over 98% of businesses, 55% of private sector employment and over 40% of private sector turnover.²³⁰ Collectively, they have a powerful impact on the shape of Scotland's workforce. This is notably the case for STEM-related industries: 'professional, scientific and technical activities' is the largest sector for SMEs with almost 53,000 enterprises, while construction encompasses another 45,000.²³¹

The policies and practices that can be developed to improve gender equality in STEM businesses and industry are relevant to organisations of all sizes. Perhaps unsurprisingly, awareness of and action on gender equality is more widespread among larger employers. As noted by the European Commission *"SMEs lack time, means and expertise to implement efficient and integrated diversity policies. They have more urgent operational concerns and usually fear to commit to diversity because they deem diversity management policies too onerous, as well as too logistically and strategically demanding"*.²³²

Yet, the benefits of improved equality and diversity have equal, if not greater, potential impact on small businesses. In small teams, the performance of every individual has a significant effect on performance overall, and therefore SMEs may benefit most from access to the best talent; more innovation, creativity and flexibility; a corporate culture that promotes staff wellbeing (and productivity); and a positive external reputation.

Moreover, structural changes, including increased legislation and regulation with respect to equality in the workplace and standards set for companies bidding for large procurement contracts, are placing pressure on employers of all sizes to engage in the equality agenda.

Recent years have seen the development of a range of central tools and best practice guides aimed at supporting small and medium-sized employers to develop and implement good equalities practice. These have a role to play in supporting employers who have an interest in the issue to take the first steps towards reforming their workplace practices.

A step change in SME engagement, however, calls for more strategic, targeted support. For many small employers, the perception of action on equality as complicated, costly and burdensome, can only be overcome through dedicated, tailored intervention. With over 363,000 SMEs in Scotland, the size of the challenge is significant. For this reason, it is imperative that a strategic approach is taken to provide oversight on the numerous channels through which public agencies and third sector bodies (e.g., enterprise agencies, training providers, chambers of commerce, sector skills bodies) engage with SMEs, in order that support on equality and diversity is embedded within all activity.

²³⁰ Scottish Government, March 2017, *Businesses in Scotland*

²³¹ Ibid

²³² European Commission, 2015, *Diversity within small and medium-sized enterprises: best practices and approaches for moving ahead*

Engendering STEM

A new collaboration between Equate Scotland, City of Glasgow College and partners in the Netherlands and the Basque Country, ENGENDERING STEM offers support to SMEs in the STEM sector to take steps to enhance gender equality.

This support takes the form of a free online self-assessment tool and one-to-one consultation support which identifies manageable and incremental steps that employers can take to improve their gender balance. In addition, the scheme offers SMEs the opportunity to showcase, and learn from, good practice on equality on the European stage.

<http://engenderingstem.eu/>

6.3.6 Partnership working to deliver progress towards gender equality in STEM business and industry

Finally, we point again towards the importance of partnership working to step up efforts to improve gender equality. We have discussed in detail the key role of employers in working closely with educators to support more young people, male and female, into STEM careers.

But there is also much more that industry can achieve by strengthening partnerships within sectors. Industry bodies and skills councils are ideally placed to provide leadership on the equality agenda: raising awareness of the benefits of diversity and sharing knowledge and best practice relevant to their own sectors.

Inspiring Girls to choose Digital Technology

The Digital Technologies Skills Group, which advises on the implementation of the ICT & Digital Technologies Skills Investment Plan for Scotland, has established a dedicated Gender Workstream to develop and implement a joint action plan to take advantage of the opportunities to attract females into the sector. The workstream, led by Skills Development Scotland in partnership with industry, educators and public sector organisations, has commissioned research²³³ to gain a better understanding of the extent of the gender gap in Scotland and the barriers to women entering the digital technologies sector. It has also developed a guide²³⁴ for digital technologies employers, with best practice examples and advice on practical steps to attract and retain more women in digital tech careers.

²³³ Digital Scotland Business Excellence Partnership, 2017, *Tackling the Technology Gender Gap Together*

²³⁴ Digital Scotland Business Excellence Partnership in partnership with Equate Scotland, 2017, *Tackling the Technology Gender Gap Together: A Best Practice Guide for Employers*

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As in education, there is a sense that much is happening on gender equality in the workplace, but that a lack of strategic oversight results in overlap, duplication of effort, inconsistency and gaps in interventions. There is clear potential for the Enterprise and Skills Strategic Board to take on a wide-ranging oversight role, working with industry bodies, trade unions and umbrella organisations aligned with the range of STEM industries. A coherent, collaborative approach could usefully map employer activity on gender equality, celebrate successes, share best practice and resources, and highlight gaps. The Board's commitment to develop a performance framework which includes addressing gender inequality as a key objective signals a move in this direction.

Business and industry: next steps to consider for progressing gender equality in STEM

- Ensure that the importance of gender equality is **consistently reflected in organisational values, policies, practices and performance measures** (e.g., appraisal frameworks, promotion criteria), to secure buy-in at all levels.
- **Publish strategies** on gender equality within organisations and sectors, with clear targets and plans for action; **improve data collection and analysis** to monitor progress.
- **Enhance progressive policies, practices and organisational culture**, particularly in relation to providing and normalising high-quality part-time and flexible work, positive perceptions of shared parental leave, and innovative gender-neutral recruitment and promotion processes.
- **Invest in women's networks and positive action measures** proportionate to overcoming challenges of severe under-representation of women in STEM industries.
- **Set up partnerships with equalities organisations** and deliver programmes of work together to achieve holistic change within companies.
- **Map engagement with STEM SMEs** to identify where support for developing good practice on equalities can be delivered.
- **Develop sustained partnerships with schools, colleges and universities** to support the delivery of multiple interventions aimed at encouraging girls and young women into STEM.



7 Gender Equality in the STEM Workplace: academia

Representation of women in the Scottish STEM academic workforce

Tapping All Our Talents 2012 highlighted the “leaky pipeline” in the representation of women across the academic journey, based on 2007/08 statistics (Figure 9).

Figure 9: Female representation at each level in academia, 2008

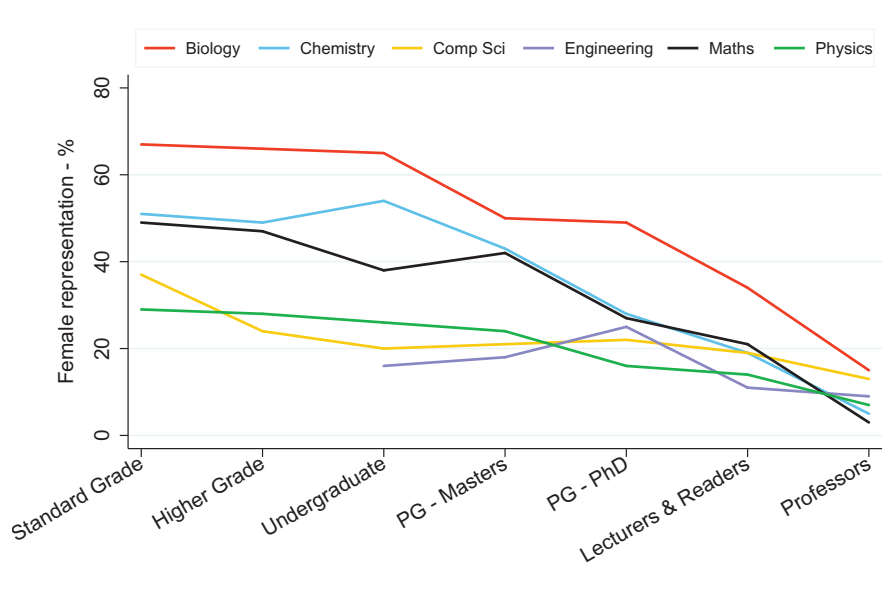


Figure 9 Source: The Royal Society of Edinburgh, 2012, *Tapping All Our Talents* p21

The statistics showed that at the first tier of academic qualifications (age 16), young women were over-represented in Biology, had approximately equal representation in Chemistry and Mathematics, and were under-represented in Computing Science, Engineering and Physics. But in all subjects, the proportion of women declined through every stage of the pipeline, with the rate of decline accelerating from undergraduate level.

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Figure 10: Female representation at each level in academia, 2017

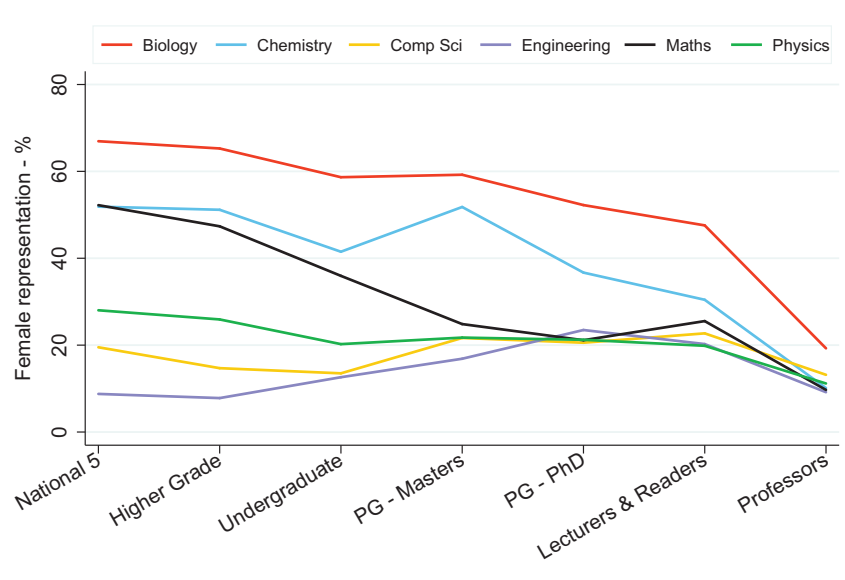
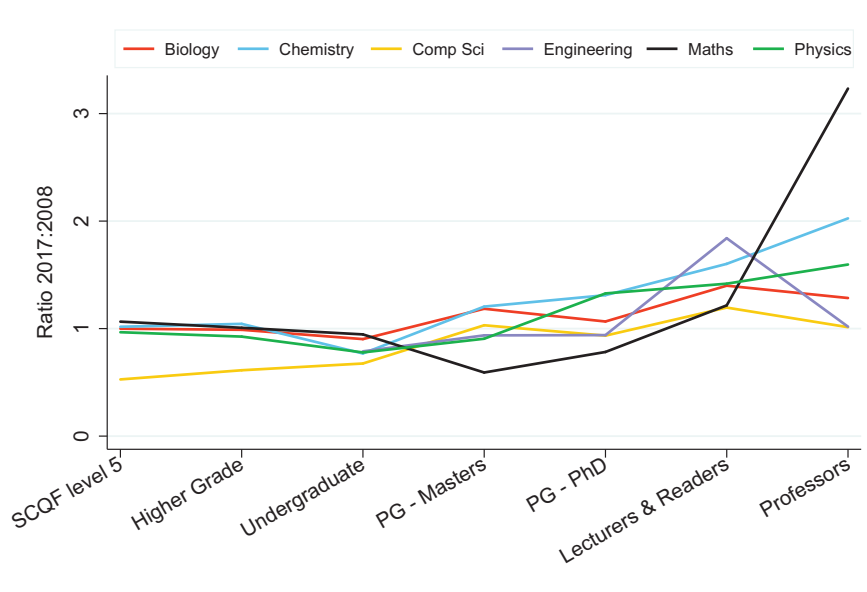


Figure 10 Sources: National 5 and Higher data sourced from SQA Attainment Statistics and refer to Scotland. Undergraduate and postgraduate data refer to UK statistics sourced from HESA Student Statistics. Data for lecturers, readers and professors are sourced from HESA Staff Statistics and refer to UK figures.

Figure 10 presents comparable data for 2017.²³⁵ It is clearly apparent that the leaky pipeline persists, but to a somewhat lesser degree. To examine the extent of change between 2008 and 2017, Figure 11 presents the 2008:2017 ratio of female representation for each subject across each academic level.

Figure 11: 2008:2017 ratio of female representation at each academic level



²³⁵ Sources: SQA Attainment Statistics (2017); HESA



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From Figure 11 we see that the rate of decline of female representation along the academic pipeline has become marginally steeper between age 16 examinations (Standard Grade/National 5) and undergraduate level, at which point all subjects, apart from Computing, exhibit a decrease in the proportion of female students between 2008 and 2017.

At postgraduate level and beyond, the picture is more mixed. Figure 10 shows that Biology, Chemistry and Mathematics continue to see falls between the proportion of women studying at undergraduate level, and those studying at postgraduate level. Encouragingly for Biology and Chemistry, the declines are becoming steadily shallower. Yet in Mathematics, the decline has become steeper.

Between PhD and Lecturer/Reader levels, the proportion of women in Biology, Chemistry and Engineering also continues to drop (Figure 10). However, Figure 11 indicates that, again, the rate of decline across all three disciplines has notably slowed. Mathematics has, in fact, reversed the decline at this stage, with a greater proportion of female Lecturers and Readers than PhD students, although this is in part due to a smaller proportion of female PhD students in 2017 than in 2008.

Figure 10 indicates the greatest falls in female representation along the academic pipeline continue to be seen between Lecturer/Reader level and the most senior academic staff: Professors. In fact, the steepness of the drop between these levels in some areas, notably Chemistry, Biology and Engineering, has increased. The progress made in raising the proportion of women at Lecturer/Reader level has not been matched to the same extent by increasing numbers of female Professors. Across all disciplines, the proportion of female Professors remains low, at between around 10 and 15%, except Biology where the figure stands at just under 20%.

Nevertheless, there has been some marked progress in increasing the proportion of female Professors in some disciplines between 2008 and 2017. Mathematics saw the largest proportionate increase in representation: starting from a very low base of only 3% of female Maths Professors in 2008, this has more than trebled in the period to stand at 10% in 2017. The proportion of female Professors in Chemistry also doubled in the period, from some 5 to 10%.

7.1 Academia: findings and recommendations 2012

The barriers to gender equality in the STEM workforce identified in 2012 and set out in Section 6.1 of this report apply equally to the STEM academic workforce as to business and industry. They relate to broad themes of the nature and organisation of STEM careers, widespread implicit bias, the impact of family responsibilities and careers breaks and access to research resources.

Tapping All Our Talents 2012: Key recommendations to universities, research institutes and research funders

Tapping All Our Talents 2012 recommended that all Scottish universities should, within two years, have in place a strategy to bring all their STEM departments to the minimum standard of an **Athena SWAN Silver award** (or equivalent); and that within three to five years the majority of departments should have achieved this level.

It noted that the following commitments are typical of the requirements for an Athena SWAN Silver award:

- **Monitoring and publishing data** on female representation, disaggregated by individual STEM subjects and by level of seniority within the institution.
- The **gender pay gap** should be tracked and published.
- The **gender balance in senior management** should be redressed.
- **Equity committees** should be established to review data and report on equality.
- Good practice should be developed on improving the **work-life balance**.
- **Equality training** should be mandatory for senior staff, and staff involved in appointment and promotion.
- Institutes and universities should provide high-quality, on-site, affordable childcare.
- Departmental provision to cover maternity/paternity leave.
- **Dissemination of information about policies and processes**, including parental leave, provision for part-time employment and promotion criteria.
- **Mitigate effects of maternity/paternity leave on long-term research performance**.
- **Staff mentoring** schemes for all early-career staff, with high level of awareness among mentors of gender equality issues.
- **Ensuring the future progression of career researchers** through enhanced training, advice and opportunities.
- Strive for gender balance in **representation on key decision-making bodies**.
- Account fairly for periods of maternity/paternity leave and part-time employment in Academic Development Reviews/**promotion** processes.

Tapping All Our Talents 2012 also noted that more could be done by funders and investors to develop incentive schemes and embed minimum standards on gender equality as conditions of research funding.



7.2 Academia: developments since 2012

7.2.1 Athena SWAN

Tapping All Our Talents 2012 made a key recommendation that all of Scotland's universities and STEM departments should work towards achieving an **Athena SWAN** silver award or equivalent; and that funding bodies should make this a condition of grant eligibility.

At the time of that report, three universities in Scotland held Athena SWAN bronze awards; two university departments held silver awards and one held bronze. At April 2017, 13 universities held bronze awards and one held silver. Across universities in Scotland, 73 STEMM departments have accreditation, with 16 at silver and one at gold.²³⁶

That almost all universities in Scotland now hold an institutional award, and with the majority of STEMM departments either holding or working towards an individual award, demonstrates a significant level of engagement by universities and research institutes in the gender equality agenda. In addition, research funders, including SFC, UKRI and the Research Councils, have specified support for the Athena SWAN charter and their intention to use such common benchmarking schemes as evidence of departmental level action on gender equality.²³⁷

Yet, individuals involved in the Athena SWAN accreditation process have expressed frustration that it is burdensome, and that the majority of additional workload falls to women. The impact of Athena SWAN on gender equality in the Scottish academic research workplace, and lessons to be considered as Athena SWAN undergoes review,²³⁸ are discussed further under 'Key Findings'.

Project Juno, an initiative developed by the Institute of Physics which is synchronous with the Athena SWAN Charter, recognises and rewards physics departments in universities that can demonstrate they have acted to address gender equality and to encourage better practice for both women and men. There are currently three Juno Champion departments in Scotland.²³⁹

²³⁶ Universities Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation. Note that the figures provided relate to Science, Technology, Engineering, Maths and Medicine (STEMM) departments. While *Tapping All Our Talents 2012* did not specifically consider gender equality in medicine, it did note that its recommendations would be of relevance to women in academic medicine (TAOT 2012, p9).

²³⁷ See, for example, Scottish Funding Council, August 2016, Gender Equality Action Plan 2016; UKRI, April 2018, *Principles and Statement of Expectations for Equality, Diversity and Inclusion*

²³⁸ For more information, see <https://www.advance-he.ac.uk/news-and-views/athena-swan-review-underway>

²³⁹ Institute of Physics, April 2018, response to *Tapping All Our Talents Review 2018* consultation

The Athena SWAN Charter

The Athena SWAN Charter was established in 2005 to encourage and recognise commitment to advancing the careers of women in science, technology, engineering, maths and medicine (STEMM) employment in higher education and research. In 2015 it was expanded to recognise work undertaken in other sectors, and in professional and support roles.

Awards can be conferred on both institutions and individual departments upon completing a demanding application process. The level awarded (bronze, silver, gold) represents the effort to further advance gender equality, representation and success for all: from a solid foundation for eliminating gender bias and developing an inclusive culture (bronze) to recognising a significant and sustained record of activity, impact and achievement (gold).

Athena SWAN requires academic and research institutions to commit to advancing gender equality at all stages along the career pipeline, including tackling the gender pay gap and removing obstacles faced by women at major points of career development. It demands that institutions acknowledge the need for commitment and action at all levels of the organisation, with active leadership at senior management level. And it expects commitment to making and mainstreaming sustainable and structural changes to advance gender equality.

7.2.2 Legislative and policy developments relevant to the Scottish STEM academic workforce

As noted in relation to industry, legislative and policy measures developed by UK and Scottish Governments in recent years, and discussed in Section 3, aim to support gender equality in the workplace. This includes gender pay gap reporting, shared parental leave, and the Scottish Government's policy to increase the number of funded hours of childcare.

However, unlike industry, universities are also subject to the **Scottish-Specific Duties for the Equality Act** and are therefore obliged to publish equality outcomes and progress, report on mainstreaming the equality duty, provide gender pay gap information, and issue statements on equal pay (see Section 3.2 and 3.3 for further information).

The Equality Challenge Unit (ECU) undertook a review of reporting by Scotland's colleges and Higher Education Institutions (HEIs) under Scottish-Specific Duties requirements in 2015. This found that, while reporting generally met minimum requirements, there was significant scope for improvement, including the collection, analysis and monitoring of relevant data; greater consistency and transparency on gender pay gap reporting; and better reporting on measurable progress rather than actions taken.²⁴⁰

²⁴⁰ Equality Challenge Unit, November 2015, *Reporting on equality: Colleges and higher education institutions' performance of the Scottish specific equality duties requirements in 2015*

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In respect of gender equality at the level of higher education governance, Scottish universities must comply with the **Gender Representation on Public Bodies (Scotland) Act (2018)** which sets a target of equal representation of women in non-executive roles on the boards of public bodies, colleges and universities; and places a duty on public bodies to take steps to encourage women to apply for non-executive positions.

Higher Education Institutions (HEIs) are making marked progress towards these targets. In 2017, 47% of directly-appointed lay members to universities' governing bodies were women, an increase of 18% from 2013.²⁴¹ Women also accounted for just under half of universities' governing body Chairs.²⁴² Yet women hold only five Principal positions out of a total of 19 in Scotland.²⁴³ It was interesting to note that in the most recent rounds of Principal appointments – Edinburgh, Aberdeen, Dundee and Robert Gordon – four men were replaced by another four men.

The **Scottish Code of Good Higher Education Governance** sets out the core principles of good governance that all institutions across the sector are expected to comply with, as part of a wider commitment to good governance as a condition of grant of public funding through SFC. The 2017 edition of the Code commits universities' governing bodies to providing leadership in equality and diversity. Governing bodies must monitor and improve their own balance and diversity, while also assuming responsibility for institution-wide equality and diversity. This includes at least annual receipt of equality monitoring reports that set out clear goals and the actions taken to achieve those goals.²⁴⁴

7.2.3 Steps taken by research funders towards gender equality in STEM academic workplaces

The Scottish Funding Council (SFC), as the key funder of universities in Scotland, has significant influence in the setting of priorities for the sector. While its Gender Action Plan, as discussed in Section 5, relates to gender equality for students, SFC sets out its expectations on universities to enhance equality for staff in a range of documents: its Strategic Plan 2015–18; its Mainstreaming and Equality Outcomes Reports; and its Outcome Agreement Guidance.

Equality considerations are embedded across the outcomes and actions set out in the SFC's Strategic Plan 2015–18.²⁴⁵ SFC commits to supporting the work of colleges and universities to promote equality and diversity by taking forward its own diversity outcomes; and to promoting equality of opportunity in the career progression of all researchers.

SFC has identified Equality Outcomes for the period 2017–2021.²⁴⁶ Three are particularly relevant to gender equality in the academic workplace:

- i) Supporting the university sector to achieve a diverse and representative workforce;
- ii) Achieving an improved and aligned evidence base for equality, informed by increased rates of disclosure across protected characteristics;
- iii) That equality and diversity considerations are evident in Outcome Agreements and across all core and strategic funding agreements.

²⁴¹ Universities Scotland website, accessed 26 September 2018, <https://www.universities-scotland.ac.uk/bite-size-briefings/gender-balance-on-boards/>

²⁴² Ibid

²⁴³ At University of St Andrews, Edinburgh Napier University, Queen Margaret University, Glasgow Caledonian University and the Open University of Scotland.

²⁴⁴ The Committee of Scottish Chairs, August 2016, *Scottish Code of Good Higher Education Governance* (2017 Edition), p14

²⁴⁵ Scottish Funding Council, November 2015, *The Strategic Plan for the Scottish Funding Council 2015 – 18*

²⁴⁶ Scottish Funding Council, April 2017, *Mainstreaming and Equality Outcome Report*

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Recent SFC guidance on university Outcome Agreements strengthened consideration of equality and diversity.²⁴⁷ It aims to ensure alignment between the outcomes set out in universities' own Mainstreaming and Equality Outcomes reports and those that institutions agree to deliver in return for SFC funding. Current guidance also aims to improve the consistency of how information is provided on equalities in each Outcome Agreement.

In 2013, **Research Councils UK (RCUK)**, the then strategic partnership between the UK's seven Research Councils, launched its 'Statement of Expectations for Equality and Diversity'. While this did not specify the requirement for any formal equalities accreditation, it did call for evidence of action on equality and diversity at departmental level, and noted that Athena SWAN awards or applications could form part of this evidence.

In 2018, a new body, **UK Research and Innovation (UKRI)**, replaced RCUK and brings together the Research Councils, Innovate UK and Research England. UKRI is a major funder of research across the UK, and a direct employer of some 7,000 people. Its current statement on equality, diversity and inclusion (EDI) commits it to demonstrating best practice in its own actions, and to taking "*a strategic lead in promoting equality, diversity and inclusion in the research and innovation landscape, nationally and internationally*".²⁴⁸ UKRI has recently appointed an Executive Champion for EDI and is in the process of establishing an External Advisory Group that will support delivery of a strategy and action plan by Spring 2019.

Annual diversity data published by the **Research Councils** over the period 2012/13 to 2016/17 highlight that overall, for those relating to STEM areas, the proportion of grant applications with female Principal or Co-Investigators remains low. The success rate for female applicants is, however, broadly in line with the success rate for applications from men, demonstrating a degree of improvement over the period.²⁴⁹

The **Research Excellence Framework (REF)**, the research quality assessment system that determines allocation of research funding to UK universities and research institutions, recognises the need to proactively address equality and diversity issues. In 2014, 51% of eligible female staff submitted to the REF, an increase from 48% in the 2008 Research Assessment Exercise (the predecessor to the REF). Yet, this proportion continues to lag behind the equivalent figure for men: 67% of the eligible pool of male researchers were selected in 2014.

While the 2014 REF put in place significantly stronger measures to enhance equality and diversity within its own assessment panels and in relation to the processes through which institutions selected staff to include in their submissions, there is more to do. This includes a commitment to equality and unconscious bias training for panel members; greater requirements on institutions to report on fair and transparent processes; and reporting action on equality and diversity issues as part of each institution's research environment.²⁵⁰

Proposals for 2021 include that, broadly, HEIs must submit "*all staff with a significant responsibility to undertake research*" and that outputs will be 'decoupled' from individuals, providing more flexibility for the number of outputs each individual staff member contributes. Consultation on these proposals is on-going through Autumn 2018.²⁵¹

²⁴⁷ Scottish Funding Council, October 2016, University Outcome Agreement Guidance 2017 – 18

²⁴⁸ For more information, see <https://www.ukri.org/about-us/policies-and-standards/equality-diversity-and-inclusion/>

²⁴⁹ For more information, see <https://www.ukri.org/files/rcuk-diversity-headline-narratives-april2017-pdf/>

²⁵⁰ For more information, see https://www.ref.ac.uk/media/1017/equality-briefing-for-panels-ref-2018_05.pdf

²⁵¹ For more information, see <https://www.ref.ac.uk/publications/draft-guidance-on-submissions-201801/>



7.2.4 Steps taken by academies and learned societies towards gender equality in STEM

Tapping All Our Talents 2012 recognised the potential role of academies, learned societies and professional bodies ('learned bodies') in driving progress towards gender equality in STEM. As bodies with high standing in their respective communities, and as research funders, they can provide visible leadership, be models of best practice and ensure that their own procedures for elections, grant-awarding programmes and award/prizegiving allow for real equality of opportunity.

With a legacy of male-dominated membership, learned bodies have a significant challenge to overcome in respect of improving female representation within their own Fellowships. Most are taking steps to do so and set out their actions in Diversity and Inclusion strategies.²⁵² While we have not repeated our 2012 survey of learned bodies, the data that are publicly available suggest that progress is being made in increasing the proportion of women among newly-elected Fellows.²⁵³

Many learned bodies are also playing a wider role in supporting gender equality within their communities. We have seen already the Institute of Physics' leading work with schools on Improving Gender Balance Scotland and its Project Juno accreditation for physics departments committed to improving gender equality.²⁵⁴ The Royal Society of Chemistry has undertaken substantial research work in this area, and created tools such as a Diversity Community Hub, a fund to support inclusion and diversity activity, and a biennial inclusion and diversity prize.²⁵⁵ The Royal Academy of Engineering has created an employer-led, collaborative Diversity and Inclusion Leadership Group, a toolkit and other resources as part of wider programme to increase diversity and inclusion across the profession.²⁵⁶ BCS, the Chartered Institute for IT, has undertaken research on gender and wider diversity in the sector, facilitates the BCSWomen network and supports a number of further initiatives to encourage women to enter and remain in computing science.²⁵⁷

While these are just a few examples of activities being undertaken by learned bodies across STEM-related sectors, they clearly demonstrate a high level of awareness of the need to engage in the equality challenge, and action for change. As with all initiatives in every sector, it is crucial that evaluation is embedded from the outset, in order that lessons on what does and doesn't work can be identified and shared.

²⁵² See, for example, Royal Academy of Engineering

<https://www.raeng.org.uk/policy/diversity-in-engineering/diversity-and-inclusion-at-the-academy/diversity-and-inclusion-action-plan>; Royal Society of Chemistry <http://www.rsc.org/about-us/our-strategy/inclusion-diversity/>; Institute of Physics <http://www.iop.org/policy/diversity/index.html>

²⁵³ At the RSE, 33% of Fellows elected 2012–2017 were female, compared to 18% in the previous five years; in 2018, the figure was 42%. See also, for example, figures from the Royal Society <https://royalsociety.org/topics-policy/diversity-in-science/diversity-data/>.

²⁵⁴ For more information, see <http://www.iop.org/policy/diversity/initiatives/juno/index.html>

²⁵⁵ For more information, see <http://www.rsc.org/about-us/our-strategy/inclusion-diversity/>

²⁵⁶ For more information, see <https://www.raeng.org.uk/policy/diversity-in-engineering>

²⁵⁷ For more information, see <https://www.bcs.org/category/19181>

7.3 Academia: key findings 2018

7.3.1 Athena SWAN

Many respondents to this Review cited Athena SWAN as one of the main drivers of progress towards gender equality in the academic workforce. Engagement with Athena SWAN demands greater buy-in from senior management, wider conversations about equality issues, more robust processes and better data collection. Some suggest that it is these data, laying bare the problems within departments and/or institutions, that has the greatest impact and is the major catalyst for change.²⁵⁸ For others, Athena SWAN has a role to play in focusing minds, setting expectations for gender parity, embedding equality across universities, and as a mechanism through which best practice can be shared.²⁵⁹

Yet it was also widely acknowledged that Athena SWAN has resulted in some unintended consequences. The process of applying for accreditation, and for renewing awards on a three-yearly basis, is extremely demanding. It is a huge, and long-term, burden on the individuals and teams involved. For many, producing the evidence required is a time-consuming task that must be undertaken on top of their 'day jobs'. Perhaps unsurprisingly, this burden falls disproportionately on women themselves, compounding challenges they may already face. In addition, there is a risk that the goal of achieving a certain level of award within a certain timescale turns the process into a tick-box exercise, with focus on quick attainment over the sustainable culture change that is required for real gender equality.

While there was clear, if not universal, support for Athena SWAN, there was also clear consensus on the need for reform. It is encouraging that the administrative burden on institutions and members of the Athena SWAN panels is identified as one of three strands of focus in the review currently being undertaken by a Steering Group on behalf of Advance HE.²⁶⁰ However, a key question relates to how to encourage men to contribute to equality actions to ensure shared work allocation.

Consideration should also be given to how the administrative burden can be alleviated through alignment of Athena SWAN requirements with Gender Action Plans, Outcome Agreements, reporting under the Public Sector Equality Duty etc. As the University of the Highlands and Islands commented, this would allow focus to be on delivery rather than chasing data.²⁶¹

7.3.2 Academic workplace policies and practices

Universities Scotland, in its response to this Review, provided an overview of common interventions on gender equality being used across Higher Education Institutes. These include reformed recruitment and promotion processes; unconscious bias training; internal mentoring and leadership programmes; support for promotion applications; and enhanced family-friendly policies.²⁶² But it also noted that universities must be open about the challenges that remain.

There continues to be insufficient **high-quality part-time and flexible positions** available in STEM academia. Further, as in industry, cultural workplace norms mean that those who do take up such opportunities are likely to face delay in their career progression.

²⁵⁸ See, for example, Academic and Research Employment Roundtable, May 2018

²⁵⁹ See, for example, Edinburgh Napier University, University of Dundee and individuals, April 2018, responses to *Tapping All Our Talents Review 2018* consultation

²⁶⁰ For more information, see <https://www.advance-he.ac.uk/news-and-views/advance-he-announces-athena-swan-review>

²⁶¹ University of the Highlands and Islands, April 2018, response to *Tapping All Our Talents Review 2018* consultation

²⁶² Universities Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation

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An issue that is particularly widespread in academia is the prevalence of **short-term contracts**, a feature of the research landscape driven by both universities and research funders (in the form of grants and fellowships). The negative impacts of short-term contracts are well recognised: high job insecurity, limited training and development, higher levels of anxiety. Female academics on such contracts are often at a disadvantage in respect of maternity leave entitlements, and the impact that taking a period of leave has on their career opportunities. Addressing the negative consequences of using short-term contracts is one of the key principles of the Athena SWAN charter.²⁶³

Regardless of contract type, universities should be more innovative in supporting academics on their **return from maternity leave, or shared parental leave**. There are some useful examples of how this can be done, such as phased returns or a period of sabbatical leave to allow for more intense focus on research activity.²⁶⁴ But such policies are not universal, and there may again be drivers – such as departmental culture, workloads, or pressures to maintain a publication rate – that prevent uptake.²⁶⁵ It is only when academic culture is such that men and women are equally likely to take up shared parental leave and flexible, part-time positions that the sector can approach real gender equality.

The need to support individuals returning to STEM research following a career break is particularly acute, as developments in STEM sectors are often fast moving. Knowledge can quickly become out of date and, while the individual maintains valuable research skills, the confidence of those considering a return to their careers is frequently low. **Returnship schemes**, such as the fellowships offered by the Daphne Jackson Trust, which support returners with a paid, part-time, flexible post, mentoring and retraining courses,²⁶⁶ have proved to be successful. There is a wealth of learning and good practice that universities and research institutes could use to increase their support for women – and men – seeking to bring their beneficial experience and skills back to the STEM research workforce.

There is little evidence of innovative approaches to introducing **fast-track career paths** for highly promising young academics that would enable them to establish themselves to a greater degree at an earlier stage, avoiding the current coincidence between key career progression points and having children.

Another long-standing issue is the call for universities to recognise, particularly in promotion criteria, the **value of all contributions** by academic, support and professional services staff; and parity between research, teaching and leadership.²⁶⁷ It is crucial that there is equality of opportunity for staff to follow the career path in which they can use their strengths; and to be fairly rewarded for their contributions. Staff should not be channelled into teaching or pastoral roles, for example, based on their gender or as a consequence of having taken one or more career breaks at an earlier stage.

As in industry, promotion criteria, and the promotion process, must be transparent and should allow for individual circumstances, such as those arising from career breaks.²⁶⁸

A 2017 review of literature on the impact of **mentoring and networks** for women in academia, found that *“Majorities and people with higher status can count on more networking and development opportunities, while minorities risk being marginalised and excluded from the channels helping to advance their careers... Networks are paramount in an academic career, and mentoring can significantly help in building a network”*.²⁶⁹

²⁶³ For more information, see <https://www.ecu.ac.uk/equality-charters/athena-swan/about-athena-swan/>

²⁶⁴ Ref to examples in AS applications/Gender Action Plans from universities.

²⁶⁵ Academic and Research Employment Roundtable, May 2018

²⁶⁶ For more information, see <https://daphnejackson.org/>

²⁶⁷ See, for example, University of the Highlands and Islands, Universities Scotland and individuals, April 2018, responses to *Tapping All Our Talents Review 2018* consultation.

²⁶⁸ See, for example, Heriot-Watt University and individuals, April 2018, responses to *Tapping All Our Talents Review 2018* consultation; Academic and Research Employment Roundtable, May 2018.

²⁶⁹ Meschitti, V. and Lawton Smith, H., 2017, *Does Mentoring Make a Difference for Women Academics? Evidence from the Literature and a Guide for Future Research*

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Both individuals and institutions responding to this Review highlighted the challenge for female STEM academics of exclusion from male-dominated informal networks; and the power of dedicated mentoring and women's networks to support career progression.²⁷⁰ Yet there remains a question of perception of women's networks as being forced; or of being unfair to men.²⁷¹ Overcoming these difficulties will require visible support from senior management, creating an environment in which the value of positive action is recognised by all.

The Aurora leadership programme,²⁷² a women-only programme run by Advance HE, was cited as an example of good practice in using positive action for positive impact on equality. Aurora supports women in academic and professional roles to develop their leadership potential and build their confidence through attending development days, mentoring and self-directed learning. It has supported over 4,500 women in UK and Ireland over the past five years and is currently subject to a five-year longitudinal study that follows the journey of Aurora participants.²⁷³

As the Scottish Funding Council, the Scottish Science Advisory Council and others highlight, **universities and departments must examine the issues, and the extent of disparities among staff, that are present within their own institutions.** It is only when the causes of gender gaps are understood *in situ* that employers, working closely with staff and taking advice from equalities partners, can develop an appropriate suite of actions, policies and practices. In addition, Equate Scotland called for better communication within institutions, noting that HEIs and colleges too often work in siloes, not sharing often excellent practice across departments.²⁷⁴

Examples of support for female academics in Scotland's universities

Scotland's universities undertake a range of initiatives to minimise gender-related disadvantage. These range from providing explicit support to female academics at junior level considering promotion (Edinburgh and Glasgow) to providing funds to cover childcare when staff are attending external conferences or training events (Strathclyde and Aberdeen).

A number of universities provide support to staff returning from extended periods of leave. These include the Academic Returners' Research Support Scheme at the University of Glasgow and mini-sabbaticals at the University of the Highlands and Islands.

Some universities operate 'core hours', meaning that meetings and seminars should take place when staff with external caring responsibilities or those who work part-time are normally at work. The use of video-conferencing and other technologies (used extensively by the University of the Highlands and Islands) also allows staff to work from home more effectively and flexibly and maximises the ability to attend meetings when physical travel is difficult.

Equality and diversity is an explicit part of the job roles of senior academics at the Universities of Edinburgh and Glasgow, a welcome development as embedding equality in senior roles was highlighted by many of those who responded to our call for evidence as critical for making real progress.

²⁷⁰ For example, see Universities Scotland, Scottish Science Advisory Council and individuals, April 2018, responses to *Tapping All Our Talents Review 2018* consultation

²⁷¹ Academic and Research Employment Roundtable, May 2018

²⁷² For more information, see <https://www.lfhe.ac.uk/en/programmes-events/equality-and-diversity/aurora/index.cfm>

²⁷³ For more information, see <https://www.lfhe.ac.uk/en/programmes-events/equality-and-diversity/aurora/the-longitudinal-study/index.cfm>

²⁷⁴ Equate Scotland, April 2018, response to *Tapping All Our Talents Review 2018* consultation

7.3.3 Leadership from the top: placing equality at the heart of academia

The influence of leadership on shaping workplaces that will either hinder gender equality or allow it to thrive, has been discussed throughout this Report. In every sector, at every stage, strong leadership will be the catalyst that drives deep culture change, securing buy-in from all staff and ensuring that equality action is recognised as a priority and responsibility of everyone.

In the academic sphere, such leadership must come from research funders: the Scottish Funding Council, UKRI and the seven Research Councils, for example. Establishing a clear and consistent link between funding and commitment to gender equality will be a significant driver of progress. It must also come from learned bodies, whose role within their communities is to recognise and celebrate top talent of all genders, to demonstrate best practice and to share knowledge of the issues involved with their sectoral stakeholders. And it must come from within universities themselves, both at top level strategic management, including from the governing body, and from departmental heads, if there is to be a level of consistency across institutions.

Academia: next steps to consider for progressing gender equality in STEM

- Ensure the **review of Athena SWAN** considers how to minimise the burden of applications, how to share the burden between male and female colleagues, how to more effectively share best practice and how to drive real culture change, avoiding a tick-box mentality.
- Enhance **progressive policies, practices and organisational culture**, particularly in relation to providing and normalising high quality part-time and flexible work, reducing the use of short-term contracts, positive perceptions of shared parental leave, and innovative gender-neutral recruitment and promotion processes.
- Support **women's networks, mentoring and leadership initiatives** to reduce the decline of female representation at every stage of seniority along the academic pipeline.
- Create **mechanisms to facilitate better communication** and sharing of learning and best practice on gender equality and STEM, both within institutions and across the sector.
- Introduce **specific requirements** on evidence of action on equality and diversity as a condition of **funding eligibility**.

8 Gender Equality in STEM in Scotland: key recommendations

Realising gender equality in STEM in Scotland calls for concerted, coherent, sustained effort across a multitude of fronts. It requires challenging deeply-entrenched societal views on gender roles in home life, workplaces and communities. It demands the transformation of perceptions of STEM through early, sustained and inspiring education and experiences. And it necessitates valuing, nurturing and celebrating the distinct contribution that women make to the workplace.

Underpinning activity at all levels and across all sectors and pathways are four themes:

- the need for **leadership** to drive culture change;
- the need for better **data** that allow real understanding and tracking of the extent of gender inequality in STEM, barriers to progress and appropriate solutions;
- a focus on **behaviour change** that recognises the benefits of gender equality for everyone and that renders bias and discrimination unacceptable; and
- strong, sustained partnerships between educators and industry to deliver **education and training** that inspires all young people to engage in STEM.

Leadership

- 1 UK and Scottish Governments must wield political leadership, influence and resources to embed gender equality in society and to drive a multi-sector, collaborative approach to tackling gender stereotypes at the societal level.
- 2 Public bodies, educators, employers and industry leaders must deliver the culture change that promotes equality. This requires strong, visible leadership from the top and buy-in at every level; e.g., through widespread gender competence training and design of performance metrics. It also calls for developing and normalising uptake of progressive policies and practices; and embedding equality and diversity into all existing activity.
- 3 UK and Scottish Governments must lead a step change in societal views on parental roles, using legislation, policies and public funding to drive acceptance that childcare is the equal responsibility of both parents. Childcare needs to be an economic and labour market priority. It requires investment and intelligent design to deliver an holistic, flexible, affordable system that reflects the reality of workplace demands, and allows women to return to work should they wish to do so.

Data and accountability

- 4 The Scottish Government, in designing the methodology of its proposed Gender Index Report for Scotland, must develop and invest in the collection and publication of STEM-specific data which, while respecting anonymity, are disaggregated as far as possible to allow for understanding of intersectionality, sectoral differences and regional variations. Transparent, accessible disaggregated data are crucial to providing a more accurate picture of the STEM sectors than current labour market data have the capacity to provide.
- 5 The Scottish Government must lead improved understanding of what works to progress gender equality in STEM. This may be through the development of an 'Intervention Tool' that maps interventions by current strength of evidence, impact and cost-effectiveness. There should be a requirement that all publicly-funded trial gender equality initiatives have strong monitoring and evaluation frameworks; and that those being rolled out further are clearly evidence based.
- 6 This has implications for the funding of bodies and initiatives, since short-term funding precludes long-term evaluation. The Scottish Government must ensure that public funding to advance gender equality in STEM is focused on delivering sustainable and scalable impact. This includes committing to longer-term funding for third sector organisations that deliver cross-sector support on gender equality.
- 7 Public and third sector bodies that support organisations to progress gender equality must consider how to assist them to build the capacity and skills required to undertake research to identify and analyse internal barriers, to develop appropriate interventions, and to effectively monitor and evaluate impact.
- 8 The UK and Scottish Governments and public bodies that require organisations to report on gender equality measures must do so in a way that drives action to address inequalities. It is not sufficient to expect organisations to comply with equalities requirements; public bodies must rigorously monitor performance on equality and hold organisations to account accordingly.



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Behaviour

- 9 The Scottish Government must target the key influencers on children and young people to challenge behaviours and attitudes that entrench gender stereotypes in the next generation. The RSE welcomes the Scottish Government's commitment to action on this issue in its Programme for Government 2018-19 and urges it to prioritise activities that will have the greatest impact, with renewed focus on engaging families and carers from the early years stage.
- 10 Education institutions and employers must have a zero-tolerance stance on unacceptable misogynistic behaviour and sexual harassment in study and work places; while developing cultures that minimise unconscious bias and gender stereotyping through appropriate training for staff and inclusive/progressive organisational policies, practices and standards. Making available high-quality part-time and flexible roles as standard was highlighted to this Review as the development that would have the greatest impact on gender equality in the workplace.
- 11 More employers must move from rhetoric to decisive action on gender equality by participating in evidenced, legal and proportionate positive action²⁷⁵ measures, including the introduction of placements solely for undergraduate women. In doing so, they could draw on examples from education, including City of Glasgow College's pioneering women-only courses in engineering and construction, which have resulted in a significant increase in female enrolments in sectors where women are under-represented. Employers should look to raise awareness of the need for and impact of positive action measures and work to create a culture where "redressing the balance" of under-representation is not only accepted but celebrated and participated in by all genders within a company.

Education and training

- 12 The Scottish Government, local authorities and education agencies, working with providers of teacher education and professional learning, must ensure that all education settings across Scotland are gender aware and competent. This requires empowering teachers to recognise and remove gender stereotypes from classrooms and developing a gender-inclusive curriculum.
- 13 The Scottish Government, education agencies, early years providers, schools, colleges, universities and employers need to work in strong, coherent partnerships to deliver high-quality, inspiring and inclusive STEM learning. This must support positive, up-to-date understanding of STEM pathways and careers amongst young people and their families. The development of new regional STEM hubs and the Regional Improvement Collaboratives, coupled with the Developing the Young Workforce agenda, provide an excellent and timely opportunity to embed activity on gender equality and STEM within and across the education and employment sectors.
- 14 Recognising that single intervention does not work, industry should look to create sustainable and strategic partnerships on gender equality with schools, colleges and universities which provide both access to knowledge for teachers and pupils at the school level, and "theory into practice" opportunities for under-represented students through placements, work experiences or engagement events.

²⁷⁵ Positive action measures are proportionate measures that specifically target groups that can be reasonably considered disadvantaged in order to reduce under-representation and meet particular needs.



APPENDIX A:

Tapping All Our Talents Review 2018 Working Group

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Dr Rebekah Widdowfield, Chief Executive, The Royal Society of Edinburgh

Dr Tanya Wilson, Lecturer in Economics, University of Glasgow

Talat Yaqoob, Director, Equate Scotland

Susan Lennox, Secretariat to the Review Group

APPENDIX B:

Tapping All Our Talents Review 2018 Consultation Activities and Evidence

The *Tapping All Our Talents Review 2018* undertook a review of current literature and data, with some new analysis of existing data undertaken by Dr Tanya Wilson on behalf of the Working Group. This activity was complemented with an open consultation and a series of thematic roundtable discussions.

Open consultation

Tapping All Our Talents Review 2018: consultation questions

Q1. Do you believe progress has been made towards achieving gender equality in the STEM workplace in Scotland since 2012? (Yes/no).

Q2. If yes, what action(s) do you believe have had the greatest impact on improving gender equality in STEM in Scotland? (List maximum of 3).

Q3. Where you do not believe progress has been made, or could be improved upon, what do you believe have been the key limiting factors? (List maximum of 3).

Q4. Which of the recommendations made in the 2012 Tapping All Our Talents report do you believe should be prioritised going forward? (List maximum of 3).

Q5. What further recommendations (if any) would you make to policy makers, educators or employers to tackle gender inequality in STEM in Scotland? (List maximum of 3).

Q6. What lessons do you believe have been learned from initiatives undertaken since 2012 to tackle gender inequality in the STEM workforce across the public, academic and/or industry sectors? Examples of good practice would be useful.

Q7. In 2018's economic, political and social context, what do you consider to be the key influencers (positive and negative) on gender equality in STEM in Scotland?

Q8. To what extent do you believe that the issue of gender inequality in STEM is being recognised as a priority and to what extent do you believe that rhetoric is being met with action?

Education

Q9. What do you believe should be done to encourage more girls and young women to engage with STEM subjects in early years, primary and secondary education?

Q10. What innovative or impactful practice do you know of or believe should be taking place in universities and colleges to tackle issues of gender disparities in STEM subjects? What do you think can be done to embed STEM gender equality thinking across universities and colleges?

Cultural change

Q11. In what ways do you believe industry can lead by example to tackle inequality within workplace culture?

Q12. What do you believe are the most effective ways to challenge and change deep-rooted attitudes and institutional culture in order to improve gender equality in STEM?

Q13. How do you suggest culture change can be measured in a meaningful way?



Tapping all our Talents

A progress review of women in science, technology, engineering and mathematics in Scotland

The Tapping All Our Talents Review 2018 consultation was launched with an event at the Royal Society of Edinburgh on Monday 19 March and ran for six weeks.

Our thanks to everyone who attended the launch event and to those involved in preparing and submitting responses to the consultation.

Consultation responses were received from the following organisations and are available to view on the RSE website: www.rse.org.uk/inquiries.

Advance HE

Close the Gap

Colleges Scotland

Crieff High School Reading Group

Edinburgh Napier University

Equate Scotland

Heriot-Watt University

Institute of Physics

National Union of Students Scotland

Primary Engineer

ScotlandIS

Scottish Funding Council

Scottish Qualifications Authority

Scottish Power

Scottish Science Advisory Council

Universities Scotland

University of Dundee Athena SWAN

University of Edinburgh

University of Glasgow

University of the Highlands and Islands

University of St Andrews

University of Strathclyde

West College Scotland

We also extend our thanks to the individuals who responded to the written consultation.

While the majority of **individuals** requested to keep their submissions anonymous, most responses are available to view on the RSE website.



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Roundtable discussions

Throughout April and May 2018, a number of roundtables were convened to discuss gender equality and STEM around the themes of:

Primary and Secondary Education

Further and Higher Education

Academic and Research Employment

Business and Industry

Policy and the Third Sector

Women Working in STEM

Our thanks to the individuals who took part on behalf of their organisation and/or to discuss their own experiences. The following organisations were represented at one or more of these roundtables:

Close The Gap

College Development Network

College of Science and Engineering, University of Edinburgh

Colleges Scotland

Doonfoot Primary School

Dumfries and Galloway Council

EDF

Edinburgh International Science Festival

Edinburgh Napier University

Equality Challenge Unit

Glasgow Caledonian University

Glasgow Clyde College

Harper Macleod

Heriot-Watt University

Institute of Physics

Moray House School of Education, University of Edinburgh

National Parent Forum Scotland

Perth College, UHI

Robert Gordon's College

Robert Gordon University

Royal Bank of Scotland



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School Leaders Scotland

Science Grrrl

Scottish Enterprise

Scottish Funding Council

Scottish Council for Development and Industry

Scottish Qualifications Authority

Scottish Universities Physics Alliance

Skills Development Scotland

SSE

St George's School for Girls

STEM Ambassador Hub

The Young Women's Movement

Universities Scotland

University of Aberdeen

University of Abertay

University of Edinburgh

University of St Andrews

University of Strathclyde

University of the Highlands and Islands

West College Scotland

Finally, our thanks to the following individuals and organisations who took the time to speak with a representative of the Tapping All Our Talents Review 2018 Working Group:

Heather Earnshaw, Institute of Physics/Improving Gender Balance Scotland

Ian Menzies, Education Scotland

April Robertson, Skills Development Scotland

Kay Steven, Advance HE





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