

Baseline Evidence and Research Project for Gender Equality in STEM

Final report: 3. Stakeholders' views

Presented to **Welsh Government Office for
Science** by **Arad Research**

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1. Introduction

The Welsh Government Office for Science commissioned Arad Research to undertake a Baseline Evidence and Research Project for Gender Equality in STEM. Three reports (and a separate infographic summary) were produced as part of the study's final outputs:

1. Literature review.
2. Data review.
3. Stakeholders' views (this report).

This report presents the views of stakeholders interviewed during the research. It summarises the findings, drawn from interviews conducted with stakeholders and organisations with specific interest in gender equality in STEM in Wales.

1.1 Methodology

Between February and March 2020 30 stakeholders representing a range of organisations across Wales were interviewed. Interviewees included representatives from:

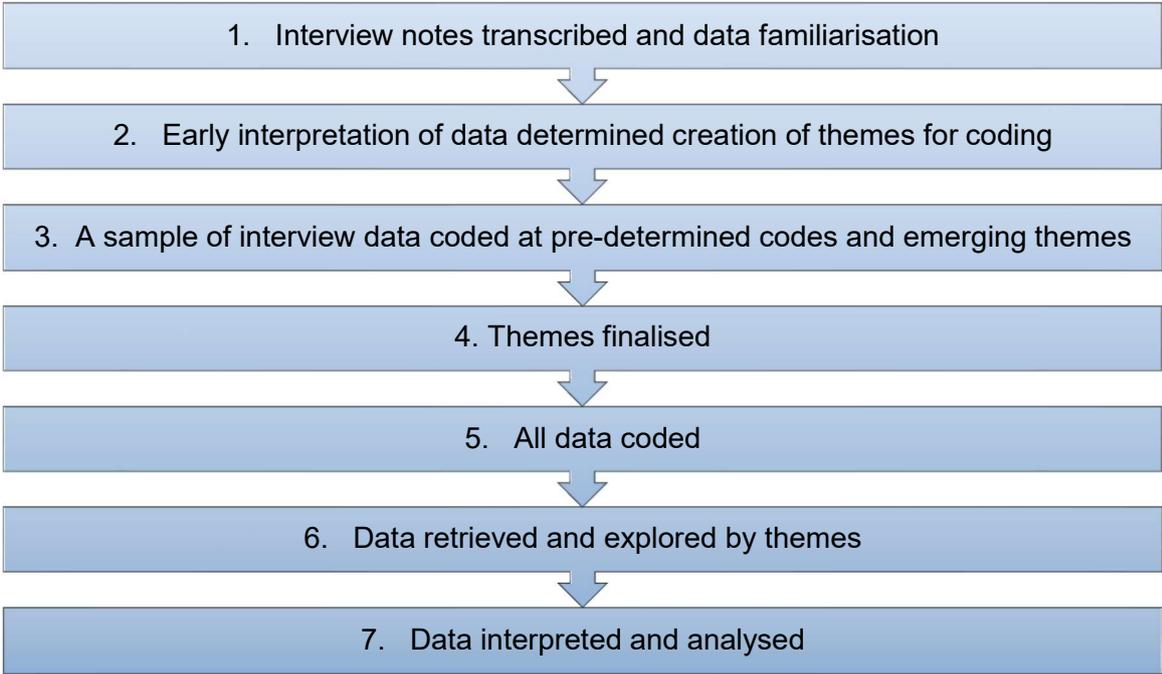
- The Welsh Government's Women in STEM Board;
- The Board's Education sub-group;
- The Board's Industry sub-group;
- Other interested parties.

Interviewees included representatives from the Welsh Government, Further and Higher Education Institutions, schools, regional education consortia, manufacturing and engineering companies, and third sector organisations promoting STEM and/or gender equality. Examples of some of the key themes discussed during interviews include:

- Views on existing gender equality in STEM programmes delivered;
- Perceptions of gender equality in STEM interventions required in Wales;
- The potential role of the STEM community in the delivery of such interventions.

An overview of the analysis process applied to the stakeholder interview data is outlined in Figure 1.1.

Figure 1.1. The data analysis process



Interview notes were written up using key notes rather than verbatim transcripts. Guided by the research questions, pre-determined themes were agreed. For example, ‘examples of activity’, which included sub-categories for each education phase; ‘evidence of effectiveness’; ‘interventions needed’, and factors critical to successful interventions such as ‘communication’, ‘increased profile’, and ‘monitoring and accountability’. A sample of data was coded, themes finalised, and additional themes that emerged also incorporated. Consistency of coding was ensured with each code clarified/defined, regarding content to be assigned to each theme. The coding and interpretation process used qualitative data analysis software (MAXQDA). This meant that it was straightforward to retrieve all data, with a clear evidence trail provided.

All data was interpreted and analysed, with findings presented in the following section.

2. Findings from stakeholder interviews

The following presents the main findings from the stakeholder interviews, beginning with stakeholders' preferred STEM definition and information about data organisations use to support and monitor activities. Stakeholders also discussed gender equality in STEM interventions they were either aware of, or directly engaged in delivering. Views on the effectiveness of current interventions, the role of the Welsh Government, and suggestions for future activities and measures in Wales that could contribute to gender equality in STEM are also discussed.

2.1 The current evidence base

Key findings

- **Defining which specific subjects** are included within STEM is not straightforward.
- Demand for **specific skills** e.g. digital, should be considered when prioritising activities supporting STEM subjects.
- Low and/or **declining participation figures** in some STEM fields were of concern.
- It is not clear when girls decide not to follow a **STEM learning or career pathway**; there are a number of points and reasons when and why girls/women disengage.
- The **Athena SWAN** process can positively contribute to progress in gender equality in STEM in Higher Education.
- There was some uncertainty as to how some of the **collected data** was used.
- Further **auditing of engagement** with STEM and **longitudinal tracking** of individual learners were proposed.
- While there is rich data on **STEM participation** and **attainment**, the **data on learners' attitudes to STEM** subjects and careers, particularly among younger age groups is limited.

2.1.1 Defining STEM

There was no definitive response regarding a precise definition of which subjects are included within STEM. Although the inclusion of Medicine was supported by some there was concern that if it was included this could 'skew data', portraying a 'more positive perception' of the proportion of females involved. Although the wider definition of STEM was accepted it was also proposed that there needed to be more detail provided at individual subject level regarding participation figures. Prioritisation of the targeting of interventions could reflect the situation with regard to which subjects record the least gender balanced at any particular time. With this in mind, one interviewee commented that the drive for technology and digital careers is currently emerging as a key priority.

2.1.2 Current data

Most stakeholders referred to data their organisation used or collected, to inform their activities. For instance, views on the gender breakdown by subject area were particularly noted by members of the education sub-group, with national statistics held by the Welsh Government used. The decline in participation rates for subjects such as Design and

Technology was of concern, along with the decline in BTEC entries, which are no longer counted as a performance measure. On the other hand, some stakeholders reported that they had observed an increase in women studying A level STEM subjects, but gaps were more evident in vocational subjects. Nevertheless, it was reported that girls were performing well compared to boys, but that it was not clear exactly when girls decide not to pursue STEM careers. There are a number of points and reasons when and why girls/women disengage, from the age of three upwards. There are risk points throughout, which have an impact.

'We're gearing girls up for science careers, but then losing them and it's not clear when and why exactly that happens. At the GCSE transition there's a sharp decline, but the choices are made way before that.'

Although an improved gender balance for some degree courses such as engineering was reported this was still poor compared to other areas of study. Whereas subjects such as Information Technology participation at undergraduate level was declining. There was concern regarding who was responsible for monitoring and affecting change here.

Higher Education Institution representatives commented that the data required for compliance with Athena SWAN¹ was collected along with other legal data requirements regarding pay. It was noted that Athena SWAN highlighted gender issues for institutions, for example, the gender balance of committees was reported to be addressed as a result. However, submitting data for Athena SWAN was also reported to expose unintended consequences such as the financial and time cost (administration) to achieve the compliance. Nevertheless, it was noted that without Athena SWAN universities would be disadvantaged when submitting funding applications. Project Juno² is a similar process undertaken to recognise gender equality in Physics. Both these accreditations mean institutions collect data on a range of elements such as the gender balance of job applications and visiting speakers.

All Higher Education Institutions are also required to record staff and student data by subject area, and this was reported to be useful as it provides a benchmark for institutions. Interviewees commented that data collected is 'rich' enabling an examination of the different elements of STEM, yet there was uncertainty as to how this data is currently used by institutions and other agencies, along with concern that 'too much time is focused on providing the data rather than the analysis'. One HEI representative also commented that the university collected data to allow them to explore gender differences in student performance by module, to enable the potential identification of any modules that may be particularly biased.

Those interviewed commented they would like to see data available focusing on some specific areas such as an understanding as to why universities lose women at senior

¹ [Athena SWAN](#) - Advance HE's 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.

² [Project Juno](#) – note there is a reciprocal arrangement between Project Juno and Athena SWAN.

lecturer level in STEM. Others commented on the need to understand how gendered the curriculum is – in order to clarify how gender stereotypes affect female choices. Much of the data collected for teenagers was reported to not be gendered, thus preventing comparisons. It was suggested that access to data tracking individual learners would be useful, along with opportunities to explore perceptions of STEM from a much younger age; e.g. three years old. One stakeholder noted that data on career aspirations is only collected from Year 10 pupils in Wales, which only provides a snapshot of views at a point when many learners have already made decisions on future learning and career pathways.

Stakeholders acknowledged that some interventions collect pre- and post-data, yet being able to link this to individual learners was currently not possible. A need to map all schools' engagement with STEM and track individual learner experiences would also provide useful data, potentially identifying those schools to target for STEM engagement activities. Examining nations that demonstrate a more equal gender balance in STEM could also prove useful for Wales.

2.2 Overview of current interventions

The majority of interviewees reported they had some involvement in interventions. Both the literature and data review present findings structured by education phases. This structure is also adopted here, yet it is apparent that there are a number of interventions that span more than one education phase, with some offering opportunities to all school-aged learners. Several of the activities highlighted in the literature review, particularly those delivered in Wales, were mentioned during interviews.

Key findings

- STEM interventions (including gender equality) delivered in Wales report **increasing engagement** with children and young people.
- Ensuring teachers receive **resources and training** for delivering specific STEM activities is important for the sustainability of interventions.
- **Young role models** engaging with children and young people can be effective.
- A **gender balance** in the role models would ensure equality for all.
- **Training for teachers** about the opportunities available for their students is critical.
- Successful **interventions delivered in schools in other UK regions** could be introduced in Wales.
- Further and higher education institutions **deliver STEM interventions** in schools.
- **Peer recognition and awards** are important to those working in STEM.

2.2.1 Early years and primary school education

Detailed information was reported regarding participation rates for specific interventions in the early years and primary sector by some stakeholders. For example, one intervention that develops young people's computer coding skills, increased engagement from 4,755 learners in 2017 to 11,070 learners in 2019. One interviewee commented that the sustainability and success of this programme resulted because teachers were given the robot, teaching resources and training – all vital for sustainability.

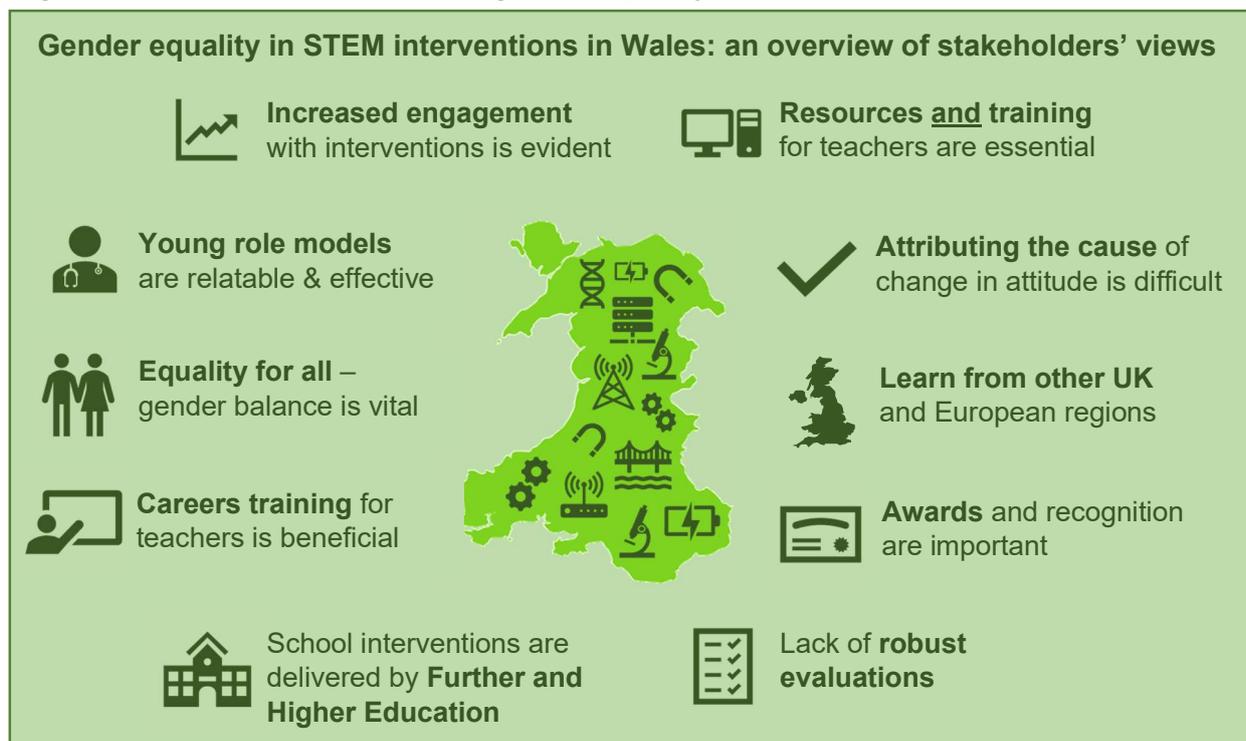
'If you have the training and the resources to take away with you then you're more likely to use them. If you're just given the resources then they'll end up on the shelf.'

Several interviewees mentioned the importance of having 'relatable young people' speaking to learners, and the necessity of delivering interventions to younger children. However, some noted that although female role models are important, delivering sessions to 'girls only' was not always perceived appropriate as 'it is not a true reflection of real life' and 'it is equality that is needed'. One education expert reported that sometimes there can be too much emphasis on inviting females into schools – there needs to be a balance.

'There needs to be more focus on it being for everyone, there should not be any positive bias.'

The findings suggest that the most appropriate approach to delivery may depend on the expected outcomes for any intervention, with activities planned accordingly. Interviewees noted that there may be times when including boys and girls together is beneficial, and that delivering to girls only could also, on occasion, be particularly important in developing their confidence. Some observed that, if mixed groups are participating in an activity perceived as stereotypically male, boys occasionally dominated, and girls disengaged. Figure 2.1. presents an overview of stakeholders' views of the current gender equality in STEM interventions in Wales, discussed in more detail in this and the next sections.

Figure 2.1. Stakeholders' views of gender equality in STEM interventions



(Map created in Piktochart)

Interviewees reported that some primary schools were delivering programmes that explored gender balance, which resulted in less stereotyping being observed, as existing societal and cultural bias was addressed. These interventions included training for primary school teachers to support communication of science to be 'gender inclusive'. However, this particular training had been piloted in England, with funding not available for delivery in Wales. iDiscover STEM³ and Fair Foundations⁴ were also mentioned as useful activities for primary schools in particular.

Variations in STEM engagement and activities across Wales were commented upon, with some schools supported by a regional education consortia STEM team and strategy; this provided schools with assembly resources for discussing STEM topics and networking opportunities for primary and secondary schools.

2.2.2 Secondary school education

One organisation delivered an intervention to more than 1,000 secondary school aged learners which provided activities and projects ranging from 10 – 60 hours of activity per learner. However, some interviewees commented that there were successful interventions delivered more widely in other parts of the UK. For example, the Science Capital Teaching Approach, which was mentioned by a few interviewees.⁵ Materials and resources are available in Welsh and the approach is currently being trialled in a few schools in Wales. A platform that connects schools and businesses, Founders4Schools,⁶ was also suggested as an effective 'brokering' approach to help schools identify appropriate STEM role model businesses who could engage with their learners, while also providing businesses with strategies for engaging learners.

An example of links between the education phases includes a project that specifically targeted physics' students in years 10 and 11. Undergraduates mentored these students, which resulted in a positive impact on participation rates for A level Physics in the schools involved. Another programme that also targets Physics provides professional development for non-specialist physics teachers; the programme engaged with 12 schools in 2014, increasing to 48 schools in 2019. However, the positive impact of the computer coding clubs in primary schools mentioned above, was reported to lose momentum when learners moved on to secondary school; as 'some pupils are more equipped than the teachers in Computer Science and ICT' (Information Communication Technology).

Several organisations' representatives commented on their school engagement work, and how they make conscious decisions to involve female employees as role models in such activities. Others noted the importance of the development of programmes focusing on links between industry and schools, with it reported that it is critical for teachers to develop their knowledge and understanding of the opportunities available for their students. Some interviewees proposed that it was necessary for teachers to receive specific training to improve their knowledge. However, stakeholders also acknowledged that it can be complex

³ [iDiscover STEM](#)

⁴ [Fair Foundations](#)

⁵ [The Science Capital Teaching Approach](#) is designed to support teachers in helping students find more meaning and relevance in science and, as a result, engage more with the subject.

⁶ [Founders4Schools](#)

to create these opportunities and bring teachers and industry representatives together. Work experience also provides opportunities for learners; one company provides approximately 30 places each year to secondary school aged students. Following an application procedure, students experience different aspects of the company; this was reported to be very beneficial for students' decision making regarding their study/career decisions.

Stakeholders described activities delivered to secondary school-aged females to develop their understanding of the role of women in STEM. Interviewees noted that these types of activities provide opportunities for young women to be inspired and offer opportunities to 'dispel the myths' about what the STEM sector is, what the entry points are and the level of earnings. However, some commented that the delivery of such programmes has encountered problems, including access to funding, and expanding engagement with schools. It was also noted that interventions do not always reach learners who most need them; occasionally the schools and specific children who might benefit most from an intervention are the ones least likely to access these opportunities.

'Ongoing funding issues mean that although it's [the programme] been developed, we rely on schools being able to pay for it and many can't.'

2.2.3 Post-16 and Higher Education

The number of interventions mentioned by interviewees which directly focused on those in further and higher education was limited. Yet, as noted above, there are interventions that universities deliver to other education phases.

The UK-wide Innovators programme, delivered by the Prince's Trust, was reported to have been successful in Wales. Women in STEM days delivered by Further Education colleges were also reported to be successful in engaging secondary school-aged learners with STEM, yet it was suggested that targeting younger learners could also prove beneficial.

Athena SWAN, mentioned earlier, was viewed by some stakeholders as 'a hugely successful intervention, it has driven change in most universities'. However, the take-up of the programme by Welsh universities was believed to be inconsistent, with leadership key to any effectiveness.

'It [Athena SWAN] really does drive change with more women being promoted; recognition and participation in leadership.'

Santander's STEMship was also considered to be a useful opportunity for university students, available across the UK.⁷

⁷ [STEMship](#)

2.2.4 Employment

Stakeholders reported that there are programmes to specifically support women in sectors where there is underrepresentation. For example, support for females to develop their leadership potential was mentioned by some interviewees. Interviewees felt that awards to support women in industry ensure that women receive tailored support and receive a higher profile, with the intention that others will be inspired. Peer recognition was considered important in raising awareness and the profile of women in some subject areas. One organisation reported that although staff members frequently receive invites to deliver at conferences and events; if there is a poor gender balance they are 'empowered to decline'. Such measures were believed to be necessary because men working in the STEM sector 'often have natural mentors', whereas these mentors are often lacking for women entering the STEM industries.

Initiatives such as flexible working were highlighted as being available for employees, but it was reported that women were not accessing this. The reason for the lack of take up was proposed to be because male counterparts were not working flexibly, and it appeared that women were fearful as to how it would be perceived if they adopted flexible working practices – 'these are the kinds of cultural barriers that impact the workplace'. This was particularly relevant for women trying to progress in academic and research careers, with motherhood often coinciding with progression to more senior posts, thus emphasising how access to childcare is a barrier for women.

One interviewee also reported they had supported successful gender STEM events, but felt that more recently there had been a lack of momentum with such initiatives. Although women-only network groups were noted as being available, sourcing the funding needed to support these was a barrier.

2.3 Views on interventions

The following presents stakeholders' views on the impact and effectiveness of gender equality in STEM interventions. Some of the fundamental elements required for successful delivery and impact are also presented, with further detail included in the following sections. It is important to note that, as reported in the literature review, there is a lack of robust evaluation evidence for some interventions, particularly those in the early years and primary school education phase; stakeholders reinforced this view during the interviews.

Key findings

- **The lack of robust evaluations** of interventions limits understanding of what effective practice looks like.
- Attributing changes in **females' attitude to STEM** directly to a single intervention is not possible.
- There are **examples of effective interventions** and activities supporting gender equality in STEM in the UK and Europe.

Stakeholders recognised that there are a wide variety of interventions being delivered across Wales, but noted that there was a limited evidence base on their effectiveness. A few stakeholders commented that 'we're awash with programmes', and suggested challenges arose in identifying what works. Some noted that, with a range of smaller organisations involved in delivery, this could be 'hit and miss' regarding monitoring quality and effectiveness. It was also suggested that at times interventions did not necessarily reflect what was actually needed.

'There are no clear answers in terms of what works. One of the issues is that many projects are not evaluated, or not in sufficient detail, so we don't really know what good practice looks like.'

In some instances, anecdotal evidence of effectiveness, such as female students observed to be 'talking more confidently about STEM' following an intervention were noted. Yet it was also reported that longer term outcomes such as an increase in participation rates would be difficult to attribute to a single intervention experienced by learners, as multiple factors could influence decision making. Anecdotal reference to the importance of culture change was also suggested, yet the lack of capacity to examine programme impact caused concern.

2.3.1 Compulsory education

Evidence of the effectiveness of interventions in other UK nations and regions was referred to by some stakeholders. For example, a gender balance in Physics project, the pilot project in Wales was highlighted earlier, used a randomised controlled trial to evaluate impact in England. A successful pilot in Scotland resulted in the Scottish Government taking responsibility for delivery in all 3-18 schools in Scotland – key elements include a ‘whole school approach and sharing of best practice’. One education stakeholder reported that reliance on external delivery of interventions was not sustainable; ‘taking students off timetable for a day doesn’t work’. At times such activities felt ‘tokenistic’, with a risk that only girls that are already engaged are reached.

‘Whether interventions are effective is a lot about the intentions, knowledge and expertise, and resource within the organisation leading it as much as the intervention itself. It’s hit and miss and there are no quality standards or best practice, so lots of small organisations are doing bits and pieces without much cohesion or expertise.’

Successful work experience placements that result in training and employment later on were reported to provide a strong core of individuals keen to be role models for younger people, and provide future engagement opportunities. One education stakeholder commented that they were hopeful that the current curriculum reform underway in Wales would result in breaking down barriers and lead to ‘richer tasks and more authentic learning experiences’. It was also noted that there is potential for the school inspection process to positively impact gender equality in STEM if school inspections examined gender balance too. The significance of females’ perception of themselves in a science career was also discussed.

‘It’s more important that people talk about the types of people who scientists are so the characteristics of the scientists rather than the job itself. [...] You’re more likely to engage girls by talking about this person enjoys the challenge because she’s really curious, and she likes to work with other people, so actually it’s about the characteristic of the person rather than what they do that girls relate to.’

2.3.2 Post 16 and higher education

It was noted that more females are now studying Physics A level but, although this may be perceived as the consequence of an effective intervention, as mentioned earlier, identifying exactly what this can be attributed to is difficult.

2.3.3 Employment

Communities of Practice were discussed, with specific reference to the Funding Organisation for Gender,⁸ an international project that focuses on good practice and

⁸ [FORGEN](#)

collecting consistent data to promote gender equality in research and innovation. One stakeholder believed that gender equality in STEM in the UK compared favourably to other nations, and another proposed that Wales could look to other nations for successful initiatives, e.g. an increase in numbers of female professors in Scotland.

National gender in STEM events were considered to be a way of successfully energising the sector. Stakeholders proposed that annual reviews of key Welsh Government commitments relating to gender in STEM should be incorporated into these, to raise the profile of the national strategic commitments, maintain scrutiny and ensure focus from other stakeholders. It was felt that sharing evidence on successful initiatives would be critical to this. Some proposed that those in positions of leadership needed to be more accountable, with targets set for expectations to be achieved over a realistic timeframe.

Although women in STEM networking events and conferences were reported to be successful in raising awareness, it was believed that more focus needed to be directed to proposing the solutions to address gender equality in STEM.

2.4 Perceived gaps/needs

Stakeholders also discussed what they considered to be gaps in the interventions currently delivered. Some of the issues raised are indicated above, and this section expands upon this providing more detailed views on the perceived gaps and what interventions and programmes are needed to address gender equality in STEM in Wales.

Key findings

- **Unconscious bias training**, particularly for teachers is considered a priority.
- The provision of **careers advice and interventions in primary schools** is important.
- **Annual events in Wales** to share practice and recognise women's achievements in STEM would be beneficial.
- Interventions that improve links and opportunities for **industry to engage with schools** are needed.
- **Work experience** and practical activities are valuable.
- Increase awareness raising for **flexible and agile working** practices.
- Opportunities to engage with young **female role models** are necessary.
- **Society and system change** are necessary to embed gender equality for all.

2.4.1 Suggested key interventions

The intervention most frequently referred to by stakeholders was the delivery of training for teachers (including during initial teacher training), with the main focus for such training to be on 'unconscious bias' and 'addressing gender stereotyping'. Such training was also perceived to be needed in other sectors too including industry and higher education. Other areas where stakeholders proposed training could prove beneficial included always ensuring all professional learning for teachers was facilitated by specialists, upskilling teachers in Computer Science and Information Communication Technology, with leadership training also deemed important.

'Leadership has a big influence on gender equality e.g. in some schools there is unconscious bias – selecting boys and girls for traditional job roles. It needs to be so natural that by the time they get to secondary school it is accepted.'

One interviewee commented on the need to improve the physical learning environment in some schools, colleges and universities if females are to engage with STEM equally.

'There are still issues with the infrastructure in the learning environment. Some engineering facilities are from the 1970s and don't have female changing rooms or toilets. Engineering facilities have a macho bias.'

The role of careers advice was also prominent; with many commenting on the need to deliver such advice throughout a learner's school career but specifically during the primary school phase, with advice tailored to individual needs. In England careers is an element of the inspection process for schools, and it was noted that a pilot in one Welsh local authority was currently exploring the application of Gatsby Benchmarks.⁹ The publication of Careers Wales programmes and progress was also suggested, as this would present evidence of impact and contribute to decision making regarding effective allocation of resources. Figure 2.2 provides an overview of the main interventions stakeholders believed are needed in Wales.

Figure 2.2. Suggested gender equality in STEM interventions for Wales



Note: the larger font size reflects more stakeholders mentioned the activity (created in WordArt).

⁹ [Gatsby Benchmarks](#) – A framework of eight benchmarks that schools can use to improve their career guidance system.

Delivering events, awards and networking opportunities in Wales could enable recognition and the sharing of best practice in gender equality in STEM. It was suggested that these events should take place across Wales, as access to London-centred activities could be prohibitive due to high cost and the lack of opportunities for early career individuals. Therefore, increasing opportunities in Wales with annual events, possibly awarding more purple plaques,¹⁰ and improving networking opportunities for early career researchers would contribute to improving the profile of women in STEM roles.

Interventions that provide opportunities for inspiring science communicators to speak to learners, potentially as a result of improved links between industry and schools were suggested as ways of delivering better engagement opportunities for learners. Stakeholders also suggested that the following types of activities were important in promoting STEM pathways and improving the links between schools and industry:

- More resources for schools to use during assemblies and lessons, including resources to target engineering and technology;
- Activities that would offer problem solving and creativity in primary schools;
- Vocational versions of GCSE qualifications;
- Work experience placements;
- Engagement with practical skills for learners were also highlighted.

'Industry needs to invest interest in issues surrounding women in STEM; it is within industries' best interest to get into the schools and talk to the pupils.'

Interviewees considered that there was a need for improving awareness of flexible working opportunities, including better promotion of shared parental leave. However, access to childcare support was believed to be a significant factor in the successful delivery of flexible and agile working practices, particularly during maternity leave and upon return to work; it is important for women to be considered equally to their male counterparts. This issue was also reported to impact upon promotion opportunities for women, and some interviewees suggested that quotas could be considered to address this. Showcasing organisations where such practices are working would also improve opportunities for equality for women, as a result of an increased profile and importance across society as a whole.

Improving links between schools and industry has already been noted as an issue stakeholders considered necessary to improve female equality in STEM. The importance of enabling learners to engage with young female role models was particularly emphasised, with such engagement particularly significant for learners in primary schools. Some stakeholders highlighted the importance of role models that were in the early stages of their career, as they would be seen as being more relatable to learners.

¹⁰ [Purple plaques](#) – are awarded to recognise remarkable women.

'I still think however, that role models the girls can identify with are the most important and effective way to challenge stereotypes and encourage girls into STEM careers.'

Focusing on primary schools was not only highlighted as a route for learners to engage with role models but was also perceived as important for the delivery of all gender equality in STEM interventions. Stakeholders emphasised that interventions are needed earlier in the education 'journey'. Visible high-profile role models in society as well as in education was also considered important by those interviewed. It was suggested that this should include more opportunities for primary school teachers to improve their understanding of STEM, to ensure they are knowledgeable and skilled in supporting learners to understand what opportunities there are for them. A specific focus on improving access to 'science capital' for more disadvantaged learners was also proposed. One stakeholder proposed that creating an opportunity to deliver a careers gender intervention to every primary school in Wales every year could lead to longitudinal tracking of individuals.

'We need to focus on primary schools, this is the age that is most influential. We need teachers to understand the issues and teach in a gender inclusive way. A kitemark or similar [could be introduced] - something that showed publicly what good schools were doing.'

Other interventions and issues were raised by stakeholders, but to a lesser extent. For instance, altering and improving the Athena SWAN accreditation for application in academia and industry with a focus on ensuring the general public could understand it would be beneficial in showcasing better practice and raising profiles. However, it was also noted that it was necessary to explore how there could be a 'move away from project-based interventions to embedding practice'.

Stakeholders emphasised that society and system change are needed to embed gender equality for all. Improving workplace culture was identified as having the potential to reflect improved gender balance and equity. Interviewees noted that embedding gender equality within the culture of organisations, as opposed to 'a tick box exercise', would contribute to wider cultural change – focusing on 'gender equality across the board'. It was acknowledged that this may require broader public campaigns to alter public attitude.

'It is an ethos, so that by the time they get to secondary school the opinions and attitudes are embedded. From a young age it is instilled in the children that they can achieve anything they want to – not just in STEM.'

2.4.2 Delivering successful interventions

Examples of specific interventions were presented above, yet for these to be successful certain elements need to be assured. The following summarises the key points offered by stakeholders.

Key findings

- **Gatekeepers' knowledge** of STEM careers needs to improve.
- Engagement with **primary schools** is critical.
- **All communities** should be engaged to ensure equality and inclusion.
- **Accountability and monitoring** of interventions are critical to determine impact.
- Accurate **data collection and learner tracking** are needed.
- Improve **communication and the profile** of gender equality in STEM.
- Consideration of interventions within **schools' competing priorities**, such as the implementation of the new curriculum, may provide opportunities.

As discussed above teachers' knowledge and skills were suggested to benefit from interventions. However, as teaching is a graduate profession it was considered that teachers often have 'a poor understanding of what industries look like'. Although their subject knowledge is not disputed, their knowledge of the different sectors and careers available can be restricted. As a consequence, a key factor to ensure interventions are a success and supported effectively by teachers would be to improve the knowledge and skills of these 'gatekeepers', as they are the people who decide what activities will be offered to learners and in some instances select specific individual learners to participate.

'Teachers have said to me 'I had no idea that that's what engineering was, I thought it involved getting your hands dirty'. If the teachers have no idea they cannot help the students.'

For example, one stakeholder commented on the increasing tendency for schools to put forward mainly boys studying sciences and Maths to participate in industry engagement activities; with another commenting on the need to engage with Arts students too, as 'many of them have the skills that are needed'. In some instances, it was noted that schools selected the less academic students to participate in engineering activities, which suggested a lack of understanding as to what engineering and STEM careers entailed. Delivering quality careers advice across all levels of education would also support these activities. Ensuring access to careers advice and gender interventions are delivered to all younger learners was considered to be particularly valuable.

'If you start them young enough, it will happen by the trickle effect. [Then] There does not need to be any specific girl-only event.'

Table 2.1. summarises the factors perceived to be critical for the delivery of successful gender equality in STEM interventions discussed in this and the following section.

Table 2.1. Critical factors for successful gender equality in STEM interventions.

| Some factors stakeholders perceived to be critical for the delivery of successful gender equality in STEM interventions in Wales | | |
|--|---|---|
|  | Gatekeepers' knowledge | <ul style="list-style-type: none"> - Career advice - Understanding of industry - Gender stereotyping - Unconscious bias |
|  | Engagement with primary schools | <ul style="list-style-type: none"> - Inspirational role models - Links with industry - Early career advice - Gender equality focus |
|  | All communities engaged | <ul style="list-style-type: none"> - Diversity - Young people - Parents - Disadvantaged |
|  | Accountability and monitoring | <ul style="list-style-type: none"> - Target setting - Explicit funding requirements |
|  | Data collection and learner tracking | <ul style="list-style-type: none"> - Longitudinal impact - Individual learners |
|  | Communication and profile | <ul style="list-style-type: none"> - Clarity across all sectors - Common approach for government departments |
|  | Schools' competing priorities | <ul style="list-style-type: none"> - Time - Resources - Curriculum pressures - Logistics of delivery |
| Welsh Government and partners | | |
|  | An overarching body | <ul style="list-style-type: none"> - Co-ordinate, manage and support delivery - Broker links between schools and industry |
|  | Communication and awareness | <ul style="list-style-type: none"> - Intervention opportunities for schools - Funding available - Wider awareness of gender equality - Sharing of good practice |
|  | Accreditation | <ul style="list-style-type: none"> - Commitment from senior leaders and governance - Pre-requisite for funding applications |
|  | Funding | <ul style="list-style-type: none"> - Flexible objectives - Equitable gender balance stipulated - Longer timescale for projects |

Leadership was also proposed to be key in addressing the gender equality agenda, with stakeholders noting that this would impact the level of priority accorded to the issue by schools, industry and organisations.

Interviewees considered that including all communities in interventions and engagement activities would ensure equality and inclusion. Providing access to intervention activities such as role models and inspirational speakers for children in all areas was believed to be able to achieve this. However, ensuring those delivering interventions reflect their target audience was also seen as critical. Even though targeting a particular community during the delivery of an intervention may demonstrate successful participation and outcomes, once an intervention finishes, interest in STEM can decline. Thus, illustrating the importance of training teachers to be influential. Including learners in developing effective interventions would also be advantageous, along with engaging with parents. Ethnicity and gender are part of this, with disadvantaged boys also requiring priority if the broader inclusion agenda and STEM are to be addressed.

Stakeholders noted that a lack of diversity within organisations can also impact the levels of bias experienced. Employers noted the role of flexible working in addressing inclusion, e.g. single parents' ability to work, as well as ensuring women are not 'lost' from a profession.

'There are issues around seniority, childcare, job flexibility – all of these things still need to be addressed – we are still not seeing parity. Flexible working is still not the cultural norm in [research and academia].'

Indeed, gender equality opportunities were perceived to need to underpin 'the whole community', including an ethnically diverse teaching workforce.

'Inclusivity is the key thing - gender, ethnicity, disabilities. There is no harm in having female-specific interventions, but it is more sustainable to make STEM activities in general more inclusive and removing gender barriers/stereotypes.'

To determine impact, accountability and monitoring of interventions is considered critical. The Welsh Government have a key role in this, particularly in target setting to redress gender imbalance. Although the School Inspectorate examines STEM curriculum in schools there is potential to highlight gender equality issues too, along with addressing inclusion more widely.

As noted above, it has been suggested by stakeholders that no clear answers exist regarding 'what works', a result of a lack of robust impact evaluation of many interventions and activities: we don't really know what good practice looks like'. Funders' requirements could be made more explicit, with funding leverage used to provide specific reporting indicators. However, in order to gauge effectiveness, learners/participants need to be followed for a long period of time; longitudinal impact may be preferable to programme

monitoring, with accurate data collection and individual learner tracking suggested for a large cohort. It was also noted that, unless factored into intervention, funding monitoring and evaluation costs are prohibitive for smaller scale activities/organisations. The focus for evaluations tends to be aimed at establishing if an intervention delivered what it applied to do, rather than examining any long-term impact.

Interviewees felt that consideration of where interventions sit within schools' competing priorities is also important and may affect the opportunities available for delivering gender equality in STEM activities. Finding time and resources for relevant training for teachers was reported to be a barrier to initial engagement, and further gender equality in STEM activities in schools. Competing curriculum pressures also present barriers with emphasis and increased timetable allocation awarded to some subject areas (e.g. Mathematics and English). Some felt that this could potentially imply that some subjects are of lesser importance to learners, which can in turn result in lower levels of engagement.

Ongoing changes and pressures within the education system in Wales were also reported to impact schools' engagement in gender equality in STEM interventions. Nevertheless, it was anticipated that the new curriculum and its emphasis on authentic learning would be positive. Other school priorities can involve boys' lack of engagement and progress in reading for example and, consequently, organisations delivering girl-only activities can encounter difficulties with school engagement, as schools are seeking support to address such priorities. Logistical issues can also be encountered when delivering to girls only.

The findings suggest that funding, accreditation and the mainstreaming of programmes across all sectors and Welsh Government departments are also critical to success. These issues are discussed in the following section in more detail, which presents proposals for communication and raising the profile of gender equality in STEM. Linked to this is the Welsh Government's potential role in recruiting and retaining subject specialists, particularly for physics. Encouraging STEM graduates into teaching could be part of the solution.

Adopting a whole school approach and policy for gender, which would allow for the sharing of good practice (e.g. schools not displaying gender bias), was also believed to be effective and crucial to success. Shared case studies could provide ideas and information for others in the sector.

Throughout the delivery of all interventions more robust evaluation to learn what 'really works' is also imperative to ensure gender equality in STEM moves forward.

2.5 The role of the Welsh Government and partners

Stakeholders offered their views on the role of the Welsh Government and partners specifically to support the profile, communication about, and delivery of gender equality in STEM activities in Wales.

Key findings

- **An overarching body** would benefit the co-ordination of STEM activities in Wales.
- Improved **communication and awareness** raising of gender equality in STEM is key.
- Welsh Government Ministers and officials with a gender remit could have a **higher profile**.
- **Accreditation** and/or kite marks (e.g. Athena Swan) are important.
- **Funding** of interventions could support activities over longer periods of time.

Although it was noted by stakeholders that many interventions and activities that support gender equality in STEM are evident, stakeholders commented that it could prove beneficial if the co-ordination of such activities improved. An overarching body similar to that of Equate in Scotland,¹¹ was suggested. With a brokering service for linking employers and schools together also proposed, possibly similar to the regional A2Connect initiative¹² – as ‘businesses are keen to engage, but don’t know how or who to contact’.

‘Triangulation at all levels of policy’ was also believed to be necessary; relevant policy development to deliver gender equity along with academic rigour and awareness of best practice from the international community. Clarity of who should be leading this agenda and how people could engage with it were also proposed, with it suggested that delivering activities in ‘silos’ should be avoided; as it is essential for gender equality in STEM to be part of ‘broader policy work’, with a ‘convening role for Welsh Government strengthened’. For example, links with the Gender Equality Review¹³ would demonstrate effective action. Clear female representation on boards and in public appointments would also provide high profile role models.

‘There are some brilliant people in Wales doing some great stuff and a lot of good will. The trick is to find a way of harnessing all of that – need to work together better on this – bring people together.’

Many stakeholders commented on the importance of effective communication with schools of national initiatives and increased awareness of the availability of funding for activities. As young people’s decision making is influenced by peers’ and parents’ views, it was also suggested that a wider awareness raising of the importance of an equitable gender balance

¹¹ [Equate Scotland](#)

¹² [A2Connect](#)

¹³ [Gender Equality Review](#)

generally, as well as within STEM, was communicated too. Improving specific awareness of STEM careers was also considered to be important. Increasing the profile of Welsh Government Ministers and officials with a gender remit was believed to be essential in contributing to addressing equality. Interventions' evaluation recommendations could also be taken more meaningfully and communicated widely. One interviewee discussed the potential for improved links between universities to further the application of social science research, similar to that highlighted by the Eleanor Glanville Centre's approach to interdisciplinary grant applications.¹⁴

The Athena SWAN accreditation scheme was mentioned on several occasions, with it particularly recognised as being successful in motivating change in gender balance in higher education. Yet the importance of senior leadership commitment was perceived to be vital for progress, along with recognition at governance level too. It was proposed that industry lacked an equivalent driver to Athena SWAN, and there was a need for a similar positive kite mark in the sector. However, related funding and time obligations that accompany such accreditation processes also need consideration. Yet, such accreditation or that of a similar scheme could be a pre-requisite for funding applications.

The development and delivery of gender equality in STEM interventions require funding, most interviewees reported on the importance of such funding opportunities. Examples of interventions delivered in Wales included in the literature review illustrate the range of funding bodies supporting the delivery of interventions; including the Welsh Government, European funds, the Higher Education Funding Council for Wales and third sector organisations. However, key issues of concern included funding objectives that lacked flexibility i.e. they were too prescriptive in what exactly would be funded, resulting in those engaging more closely with schools and young people having little input into the priorities. It was suggested that some funding could stipulate an equitable gender balance in the recipient organisation, along with demonstrating commitment and progress.

'If we are asked to report on something by someone who gives us money, it prompts institutions to do something.'

Overall, stakeholders considered it would be beneficial if funding opportunities were over longer timescales and more co-ordinated, with the possibility for partnership bids. Many projects are funded 'on a single year basis', with it reported that some funding opportunities no longer exist. This was perceived to apply particularly to the shift from smaller project funding to large European projects.

¹⁴ [Eleanor Glanville Centre](#)

3. Conclusions

Key stakeholders engaged in gender equality in STEM in Wales contributed to this report, which is one element of the Baseline Evidence and Research Project for the Welsh Government Office for Science.

3.1 The current evidence base

Defining which specific subjects are included within STEM is not straightforward.

Although there was general agreement for the wider STEM definition, detail at individual subject level was agreed to be valuable to support the targeting of interventions.

Although **low and/or declining participation figures** in some STEM fields were of concern, increase in female participation was reported for some A level STEM subjects. Some degree courses were reporting improved gender balance, yet concern was raised regarding who was responsible for monitoring and affecting change here. Nevertheless, it is not clear when girls decide not to follow a STEM career; there are a number of points and a range of reasons when girls / women may disengage. There are risk points throughout and it is not possible to state that one is more important than another.

Athena SWAN positively contributes to progress in gender equality in STEM in

Higher Education. Rich data was generated and was considered useful for benchmarking with other institutions. Yet, there was an administrative burden associated with this.

However, there was some uncertainty as to how some general gender and STEM data was collected and used, with suggestions for improvements in data collection e.g. all data should be gendered to enable comparisons.

Further auditing of engagement with STEM and longitudinal tracking of individual learners were proposed. Mapping of schools' engagement with STEM was also suggested, along with the option of looking at other nations that demonstrate a more equal gender balance in STEM.

3.2 Overview of current interventions

STEM interventions (including gender equality) delivered in Wales reported increasing engagement with children and young people. The importance of delivering such interventions to younger children was particularly noted. Whether interventions are delivered to mixed groups or targeted to girls only may depend on the expected outcomes, with girl-only activities reported to be particularly important to develop confidence.

Ensuring teachers receive resources and training for specific STEM activities is considered important for ensuring the sustainability of interventions.

Young role models engaging with children and young people can be effective. Yet a gender balance in the role models would ensure equality for all.

Training for teachers about the STEM career opportunities available for their students is critical, if they are to understand the prospects available in STEM for students. Successful interventions delivered in schools in other UK regions could be introduced in Wales. Further and higher education institutions deliver STEM interventions in schools.

Athena SWAN has proved successful in driving change for some universities; however, engagement with this is not consistent across Wales.

Peer recognition and awards are important to those working in STEM.

Access to flexible working practices is important, yet women were reported to not be accessing these.

3.3 Views on interventions

The lack of robust evaluations of the impact of interventions limits understanding of what effective practice looks like. It is not possible to attribute changes in attitude to STEM directly to a single intervention.

There are examples of interventions and activities supporting gender equality in STEM in the UK and Europe.

It is important to bring the expertise delivering interventions together and provide a cohesive offering to schools. The current curriculum reform in Wales could provide more authentic learning opportunities for all.

There is progress in increasing the numbers of girls undertaking Physics A level.

National gender/STEM events have been effective in successfully energising the sector and the sharing of good practice is critical for further progress.

3.4 Perceived gaps/needs

Several key gender equality STEM interventions were proposed by stakeholders, these included:

- Unconscious bias training, particularly for teachers;
- Careers advice and interventions in primary schools;
- Annual events to share practice and celebrate women's achievements in STEM;
- Improved links and opportunities for industry to engage with schools;
- Work experience and practical activities;
- Awareness raising for flexible and agile working practices;
- Engaging with young female role models;
- Society and system change to embed gender equality for all.

Training to address gender stereotyping and unconscious bias would benefit all sectors. Along with schools, such training could be delivered to all teachers during their initial teacher training period, as well as across industry and higher education. The need for

teachers to receive 'upskilling' delivered by experts was also noted, as well as opportunities to improve leadership skills.

The delivery of interventions, specifically careers advice during primary school is also important, with advice tailored to address individual learner's needs. Opportunities for learners to engage with young female role models is an essential part of these activities. The potential for the School Inspectorate to include careers in the inspection process was similarly suggested.

Delivering events, awards and networking opportunities in Wales would enable recognition and the sharing of best practice in gender equality in STEM. These would also contribute to raising awareness and the profile of women in STEM roles.

Inspiring science communicators visiting schools, and improving links between industry and schools would deliver better engagement opportunities for learners. With work experience and opportunities to engage in practical activities valuable for learners.

Implementing flexible and agile working practices would be beneficial for all. However, access to childcare presents a barrier for some workers. Recognition and a raised profile for companies and organisations delivering such working practices would also support equality.

Society and system change to embed gender equality for all. STEM role models need to have higher profiles in society. Embedding gender equality within organisations' culture would contribute to the wider cultural change needed. This could be supported by broader public campaigns on gender equality, potentially underpinned by Welsh Government funding allocations acting as leverage to achieve this.

3.5 Delivering successful interventions

For the above interventions to be delivered successfully and be impactful for gender equality in STEM, the following elements were proposed as necessary:

- Gatekeepers' knowledge of STEM careers;
- Engagement with primary schools;
- The inclusion of all communities;
- Accountability and monitoring of interventions;
- Accurate data collection and learner tracking;
- Communication and profile of gender equality in STEM;
- Schools' competing priorities, such as the implementation of the new curriculum.

There is considerable scope to improve teachers' understanding of what industry looks like and the potential career options that are available to their learners. Teachers are the gatekeepers who determine which learners participate in enrichment activities and with an improved awareness and understanding learners would be offered access to interventions appropriate to them.

Delivering quality careers advice across all levels of education would support all learners. However, access to careers advice and gender interventions for younger learners was considered to be particularly valuable. Activities delivered to mixed groups or only girls were considered to be appropriate, depending on the objectives of the intervention concerned.

All communities need to be involved in the development and delivery of interventions, with role models reflecting this, involving learners in the creation of activities and the influential role of parents also considered. Ethnicity and gender, directing for the inclusion of other groups such as disadvantaged boys presents issues from a broader inclusion agenda. Addressing diversity issues within organisations, companies and the teaching workforce is also crucial and needs to form part of the solution.

To determine impact accountability and monitoring of interventions is critical, with funders' requirements providing an opportunity for leverage. Longitudinal impact may be preferable to programme monitoring, as data collection and individual learner tracking may provide better evidence of change and impact. Clear communication and a drive to raise the profile of gender equality in STEM is also vital to support change.

Consideration of interventions within schools' competing priorities may provide opportunities for gender equality in STEM activities. Barriers to engagement in schools can involve lack of time, availability of resources, and competing curriculum pressures. A whole school approach to gender equality could provide a solution, with robust impact evaluations of activity important for progress.

3.6 The role of the Welsh Government and partners

The profile, communication and delivery of interventions targeting gender equality in STEM in Wales would benefit from:

- An overarching body to co-ordinate activities;
- Improved communication and awareness;
- Higher profile for Welsh Government Ministers and officials with a gender remit;
- Accreditation and/or kite marks;
- Funding interventions over longer periods.

The delivery of the many different interventions across Wales is recognised, yet there is potential for improved co-ordination of this via a single umbrella body. Brokering activity to link industry and education could fall under this remit too.

Effective communication of available interventions and funding across Wales would increase awareness in schools and organisations delivering activities.

Gender equality in STEM needs to be incorporated within broader policy work, with female representation on boards and in public appointments promoted widely. Increasing the profile of the Welsh Government Minister and officials with a gender remit would provide a valuable contribution towards addressing the gender imbalance.

There is a role for the Welsh Government to stipulate implementation of appropriate accreditation /kite marks across education and industry. Commitment from senior leadership teams within organisations is critical to the success of such processes.

A range of funding bodies support the delivery of gender equality in STEM interventions and the availability of funding programmes delivered over longer periods, with potential for partnership bidding, could be considered.

4. Recommendations

The following recommendations are informed by the evidence presented in the three elements of the Baseline Evidence and Research Project for Gender Equality in STEM, including this report – stakeholders' views, and the data and literature reviews.

Strategic leadership and communication

1. The Welsh Government could consider working with partners to develop **an overarching body**, which would provide the vehicle to co-ordinate, manage and support delivery of gender equality and inclusivity in STEM activity in Wales. The body would need to collaborate with all education, industry, community and voluntary sectors.
2. **The development of a strong gender in STEM communication strategy** should be considered to increase awareness and the profile of key participants in STEM in Wales. This should include Welsh Government Ministers and officials, and gender equality practices such as flexible and agile working, which would contribute positively towards embedding a societal change in gender equality.
3. **The creation of more opportunities to showcase achievement** in gender equality in STEM should be considered; with annual events, awards, ongoing networking (both virtually and in person), and the sharing of effective practice facilitated.
4. National bodies and events should ensure that **all communities are engaged** in the development and delivery of interventions, including learners, parents, different ethnicities and backgrounds to guarantee a fully inclusive approach. Role models and the teaching workforce should be diverse and relatable to the young people they are engaging.

Workforce training

5. **The development and delivery of online and/or blended learning courses** to address gender stereotyping and unconscious bias could be one of the initial activities organised by the overarching body.
6. **Gender awareness and unconscious bias training** should be completed by as many as possible;
 - primarily the school and college teaching and support workforce,
 - all trainee teachers,
 - the higher education sector,
 - other public sector organisations,
 - With the private sector also encouraged and/or incentivised to participate.

Education

7. **Opportunities to expand careers advice and employer engagement in primary schools** should be considered, upskilling the knowledge and understanding of all teachers, including those in secondary schools, of the opportunities for young people in STEM careers.
8. The potential to **incorporate careers advice more prominently into the school inspection** process should be considered, with the Gatsby Benchmarks considered as a potential tool for change.

Funding and accountability

9. **Funding organisations** should consider how to ensure organisations bidding for public funds successfully address gender equality in their organisations/companies. Setting requirements for accreditation/kite marks should be considered.
10. The adaption and/or creation of a common **accreditation process or kite mark** for schools, colleges, universities and industry, that is clear for the public to understand, should be considered. This could contribute to embedding gender equality in society and provide transparency for funders.

Addressing gaps in the evidence base

11. Further research to develop **a better understanding of why the rate of participation is declining** for girls in some STEM subjects at GCSE and A level, particularly ICT and Computer Science, should be considered.
12. **A more detailed examination of successful gender equality in STEM initiatives delivered in other UK nations and regions** and further afield should be considered to improve the evidence base and support future decision making in Wales.
13. A comprehensive **audit of the teaching workforce's STEM qualifications** should be considered by gender. This would assist in confirming key gaps, to assist in targeting recruitment, retention and training.
14. Gender equality in STEM activity in Wales would benefit from the creation of a robust **longitudinal evaluation strategy**. This should include consideration of how learners' attitudes to careers, including STEM, could be monitored more frequently at different primary and secondary educational stages. Funding gender equality in STEM interventions over longer periods would also support this.