

Gender Equality in STEM



Llywodraeth Cymru
Welsh Government

This document is a summary of the key findings of the *Baseline Evidence and Research Project for Gender Equality in STEM* completed in 2019/20 by Arad Research for the Welsh Government Office for Science.

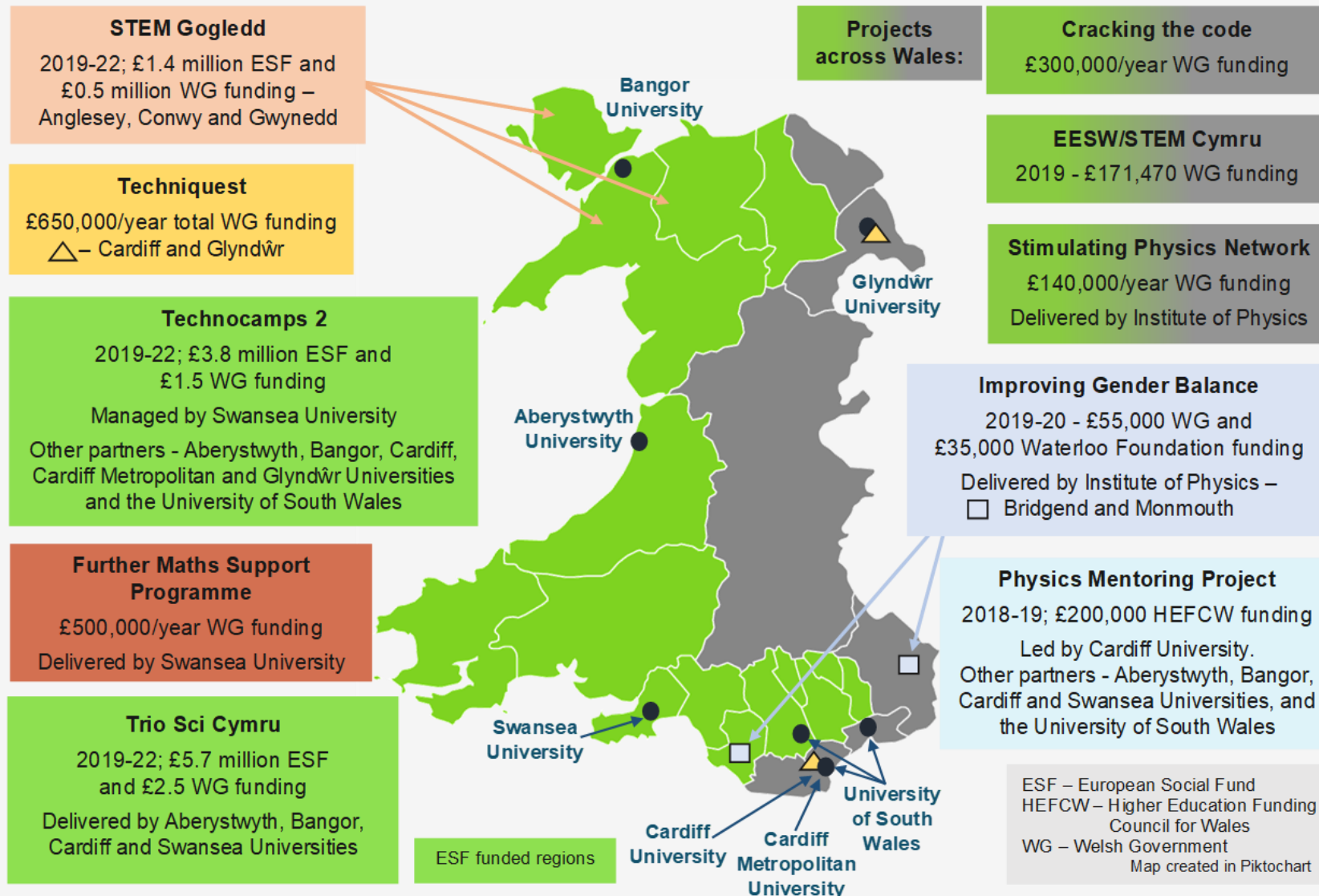
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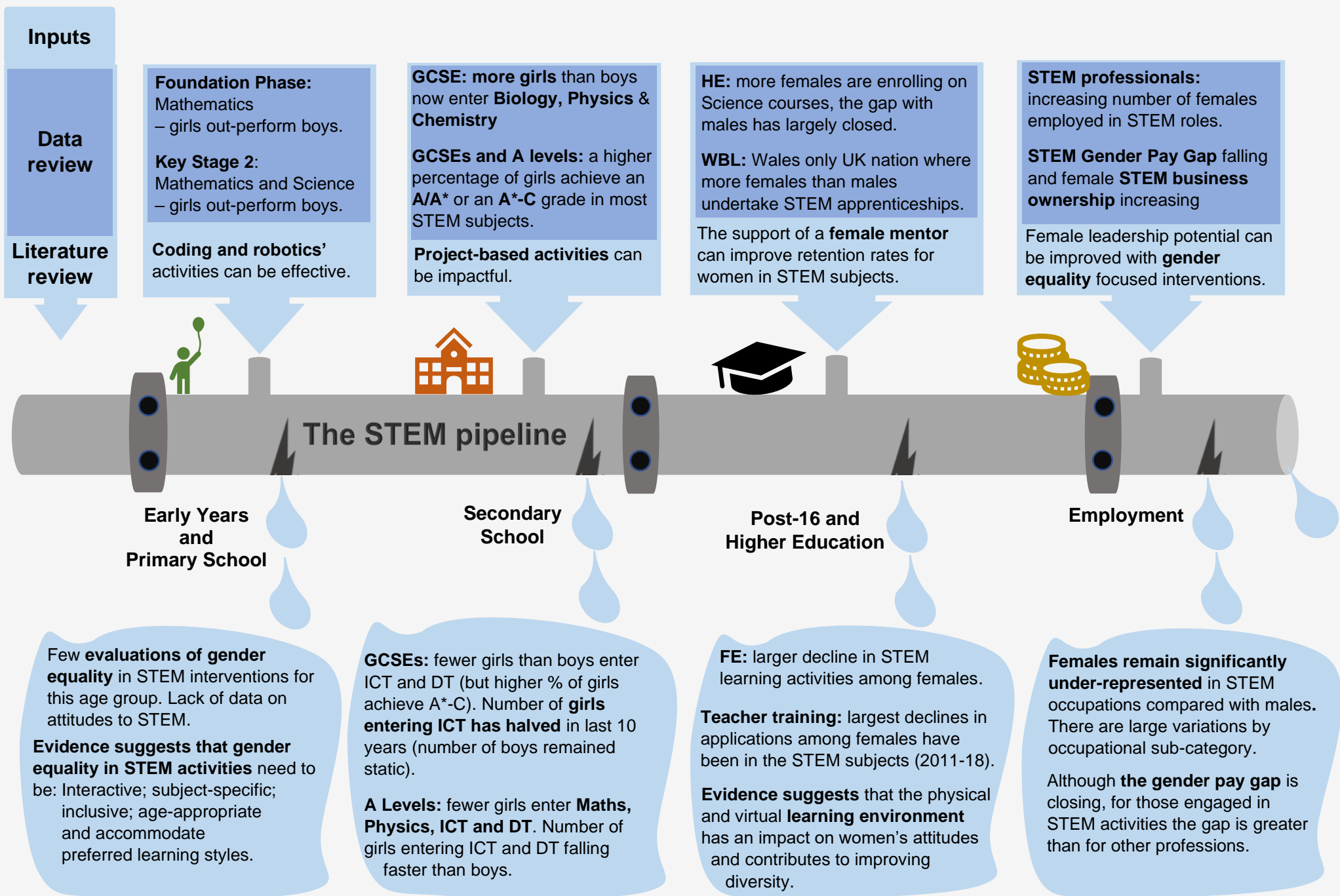
- Examples of funded STEM projects delivered in Wales
- Some key inputs to, and leakages from, the 'STEM pipeline'
- Trends and activities in:
 - ~ Early Years and Primary School
 - ~ Secondary School
 - ~ Post 16 and Higher Education
 - ~ Employment
- Stakeholders' views

For more detail on the findings please refer to;

- the data review
- the literature review
- the summary of stakeholders views

Examples of recent STEM projects in Wales





Source: *Baseline Evidence and Research Project for Gender Equality in STEM.*

Early Years and Primary School



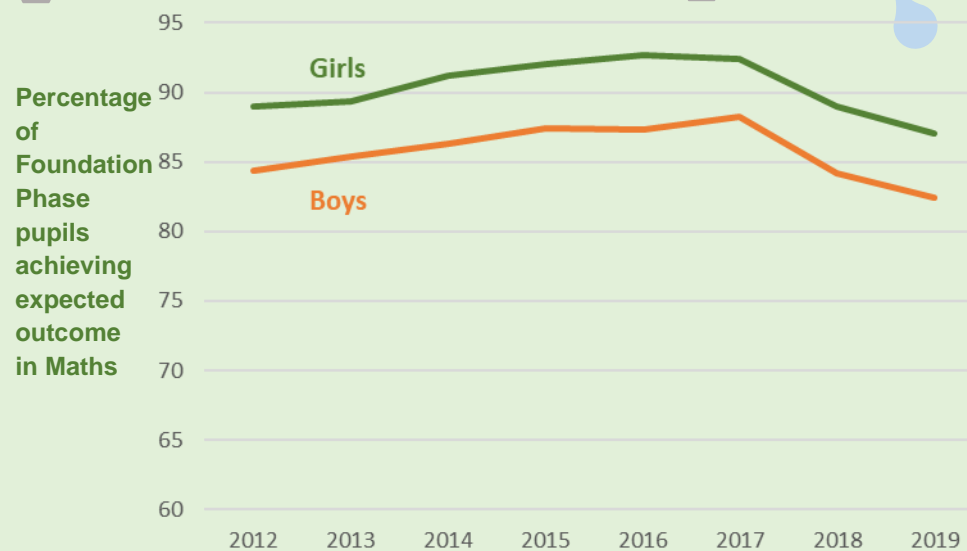
0-11 years

Learning and assessment

- Foundation Phase (3-7 years old)
- Key Stage 2 (7-11 years old)

Evidence shows that successful gender equality in STEM activities are

- Interactive and subject specific
- Inclusive and age appropriate



Foundation Phase: a higher percentage of girls achieve the expected outcome in Mathematical development each year.



Girls out-perform boys by 4-5 percentage points each year.

Source: National teacher assessment data collection, Welsh Government.

Key Stage 2: a higher percentage of girls achieve the expected level (Level 4 or above) in **Maths and Science**. This has been the case every year since 1999.



The percentage of **girls** achieving the expected level in **Maths** has typically been **3-4 percentage points higher** than boys each year.



In **Science**, the percentage of **girls** achieving the expected level has been **3-5 percentage points higher** than boys each year.

Source: National teacher assessment data collection, Welsh Government.

Other UK nations show similar patterns of girls out-performing boys at Key Stage 2.



Coding and activities programming robots

were the most frequently evaluated gender equality in STEM intervention for this age group.



Activities delivered over a reasonable time period (e.g. 5-10 weeks)

provide opportunity for children to develop an interest in pursuing STEM.

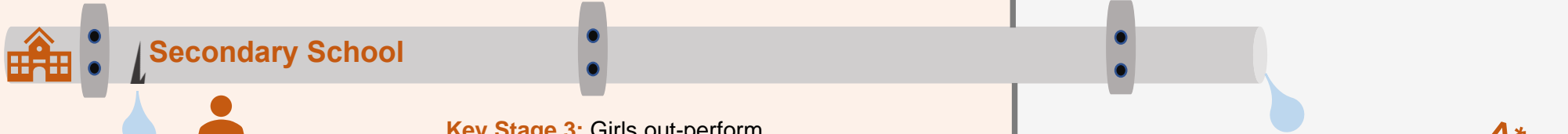
Evidence shows that...

It is important to plan for, and accommodate children's **different learning styles**.

Effective gender equality in STEM interventions also include;

- peer learning;
- learning through inquiry;
- use of multi-media;
- introducing role models.





Secondary School



11-18 years

Learning and assessment

- Key Stage 3 (11-14 years old)
- GCSEs (14-16 years old)
- A Levels (17-18 years old)

Evidence shows that successful gender equality in STEM activities are

- Practical and subject based
- Involve mentoring and role models



Maths from 2.5 (1999) to 4.2 (2019) percentage points



Science from 1.9 (1999) to 4.8 percentage points



GCSEs: The number of GCSE entries in STEM academic subjects increased by 7.3% among girls and 10.9% among boys (2008/9 - 2018/19). More girls than boys now enter GCSE

Biology, Physics & Chemistry

GCSEs

A higher percentage of girls achieve an A*-C grade in **most GCSE STEM subjects**.



The number of male entries for **ICT and DT GCSE** is more than double the number of female entries. However, a significantly higher percentage of girls achieve **A/A*** grades.



Physics GCSE: the percentage of boys achieving A* in Physics was 5.7% higher than girls in 2018/19.

Evidence shows that...



Gender equality in STEM interventions that deliver **practical /authentic real life project-based activities** positively impact female students' views of STEM-related subjects.



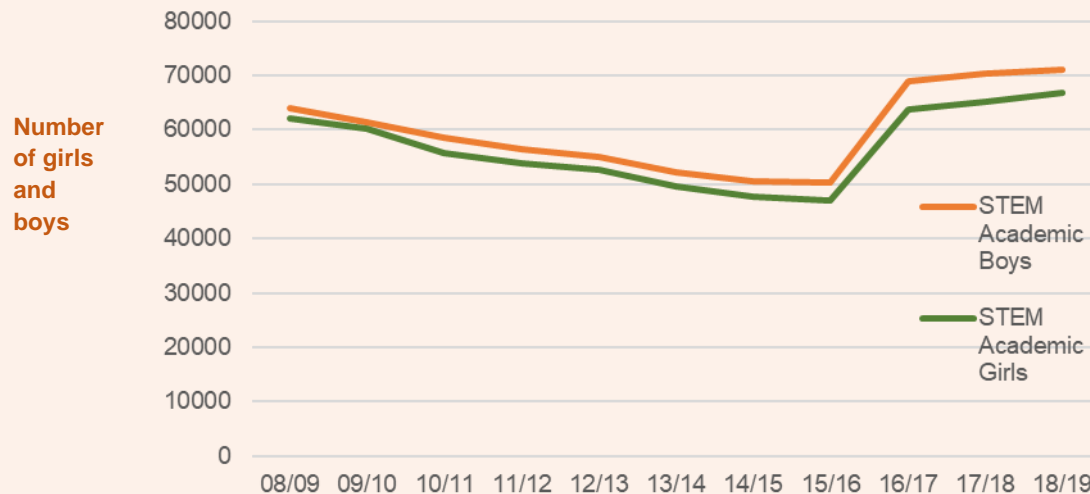
Mentoring one-to-one, online or in small groups can help girls clarify their career aspirations.



Role models engagement with role models over varying lengths of time can positively influence girls' views of STEM and stereotypes.

Parents also have considerable impact on their child's decision making.

GCSE entries: The number of girls and boys entered for STEM academic subjects.



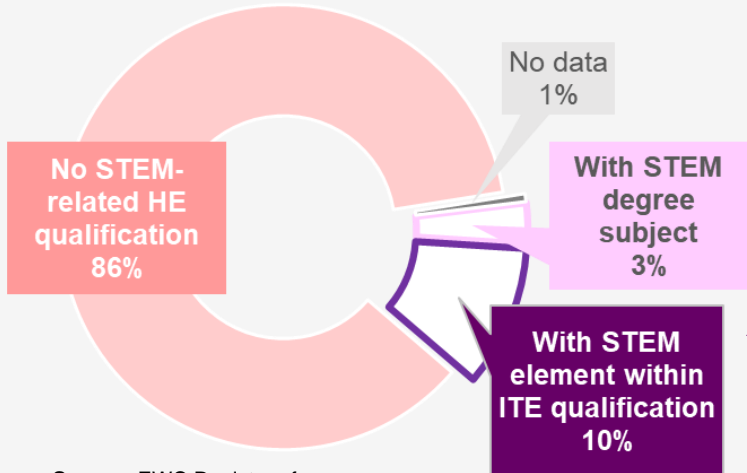
A levels: a higher percentage of girls achieved A*-C grades across all subjects except Mathematics in 2018/19.

Apprenticeships: more females undertook Level 3 and 4 apprenticeships in STEM subject areas in 2017/18.

Source: Welsh Examinations Database, Welsh Government and Pupil Level Annual School Census (PLASC), Welsh Government.
Note: the collection method changed in 2016/17.

Education workforce

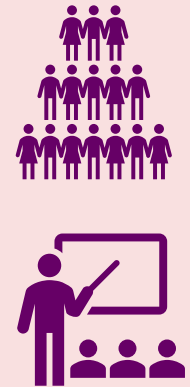
Primary stage teacher qualifications



Source: EWC Register of Educational Practitioners

Primary stage: Evidence shows that few (13%) registered primary school teachers in Wales have **STEM qualifications**

- Just 3% had a **degree or postgraduate certificate in a STEM subject** in 2019;
 - 41% of these were in General Science, 35% in Biology and 13% Mathematics;
- 10% had a STEM element within their **ITE qualification**;
 - 51% of these were Mathematics and 41% in Combined/General Science.
- 86% of primary school teachers held a qualification in a non-STEM related subject.



Secondary stage 'subject specialists'

- A lower percentage of female teachers are subject specialists in some STEM subjects (i.e. the percentage of teachers teaching subjects who trained in those subjects).
 - **DT:** 92% of male teachers trained in the subject; 68% females;
 - **Physics:** 52% males trained in the subject; 31% females;
 - **ICT** – 45% males trained in the subject; 34% females.



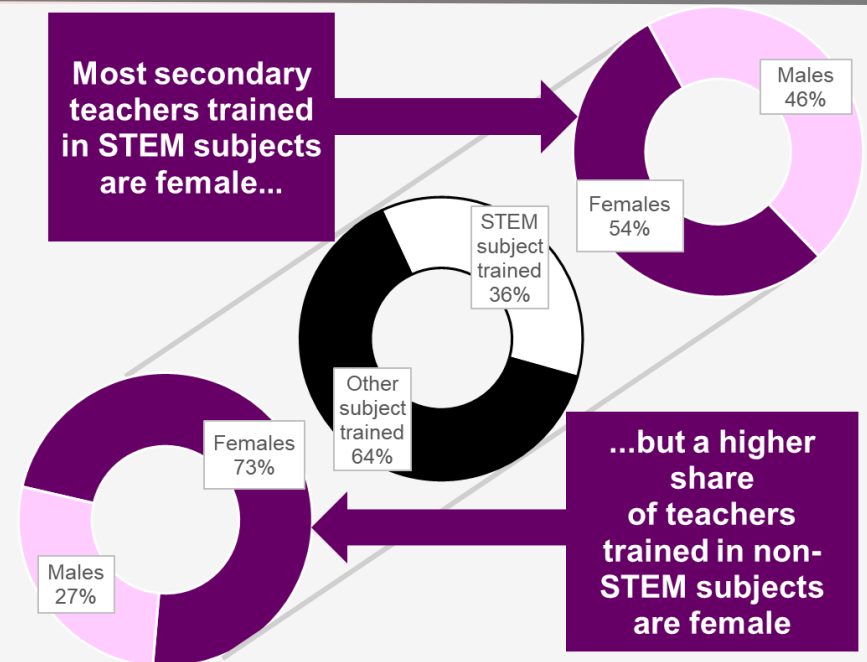
FE and WBL

- Most **FE (63%)** and **WBL (80%) STEM practitioners** are male

Secondary stage teacher profile

- Most secondary teachers (54%) trained in STEM subjects were female
- This is lower than the average for all secondary teachers (66% female) and teachers trained in non-STEM subjects (73% female).

Most secondary teachers trained in STEM subjects are female...



...but a higher share of teachers trained in non-STEM subjects are female

Source: EWC Register of Educational Practitioners



Post-16 and Higher Education



16 years +

STEM courses - by 2017/18 the number of females and males enrolled on Higher Education STEM courses in Wales was almost equal.

The Higher Education sector is frequently involved in delivering and evaluating gender equality in STEM interventions for other age groups.



Teacher training: the subjects with the largest percentage decline (2011-2018) in applications among females were:

- Physics (a fall of 67%)
- Biology (a fall of 54%)
- DT (a fall of 45%)



There was also a large decline in DT and IT male enrolment. The number of males enrolling for Social Sciences was unchanged, with a decline of 21% for female enrolment.

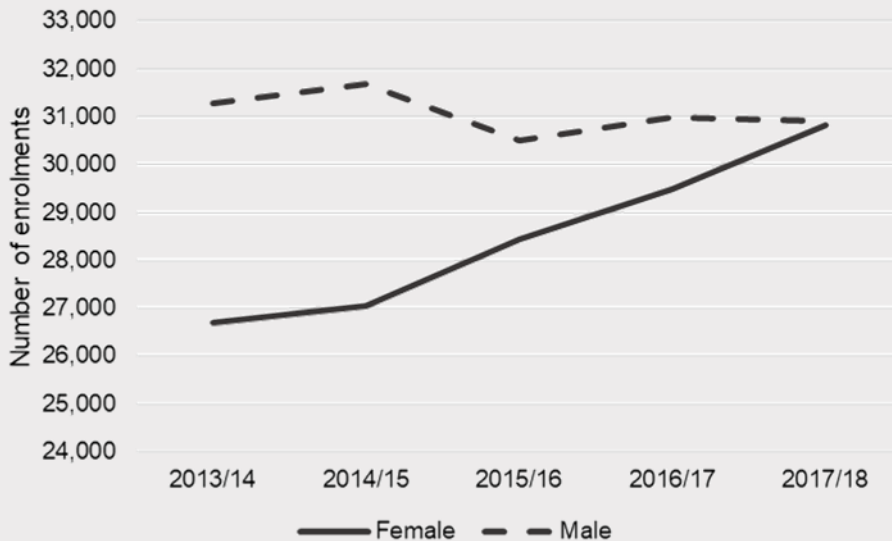


Addressing stereotypes – some gender equality in STEM interventions specifically target this. Training courses with university students develop females' sense of belonging and integration.



Mentoring – female mentors have helped with retention rates, developing larger networks and increasing female students' interest in STEM careers.

Course enrolment - Students on STEM (science subject area) degree courses at Welsh universities.



Source: HESA Student Record
(The number of others is also recorded; ranging from 5 (2013/4) to 55 (2017/18).)

Increase in female enrolments on science courses of 15.4%, compared with a fall of 1.2% among males (2013/14 - 2017/18).

Almost as many females (30,825) as males enrolled on science subject area courses (30,905) at Welsh universities by 2017/18.

The ratio of male to female **Higher Education teaching staff** in science-related areas has narrowed, but was **58% male** and **42% female** in 2018.



A range of evaluated gender equality in STEM interventions have targeted university students;

- Project-based authentic subject specific activities
- Mentoring
- Training (affirmation and gender bias)
- Virtual learning
- Peer-led tutoring and collaboration
- Exposure to role models
- Increasing numbers of females in work groups
- Addressing confidence and anxiety

All demonstrate levels of success.



Employment



16 years +

STEM professionals: From 2005-19 the number of females employed as STEM professionals increased by 28%; the number of males increasing by 33% over the same period (based on 'Science, Research, Engineering and Technology' category).

Females remain under-represented. In 2018/19:

- **11,300 females** were in STEM roles.
- Compared with **49,200 males**.

Even though sample sizes are small for occupational sub-categories, growth in the number of **females in senior IT roles has been slower** than for males.

Percentage change in number of females and males employed (2005-2019)		
Occupation	Female	Male
Technology and Communications Professionals	+30%	+93%
IT Specialist Managers	-16%	+139%

Source: Annual Population Survey (APS).

Rates of **small business ownership** and leadership appear to be increasing among females in the STEM sector, albeit from a low base.

Established **mentoring programmes**, which focus on individual STEM subjects or STEM overall, and support those employed in STEM occupations, have been delivered and evaluated in some cases, over many years.

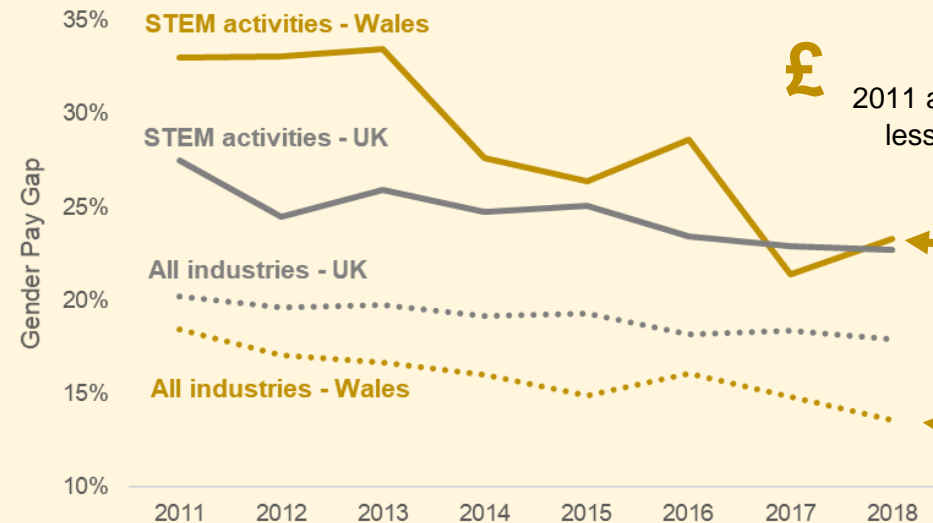
Evidence shows that...

Some interventions support the retention and progression of females in STEM careers:

- Career development programmes
- Goal setting
- Gender bias training
- Inclusion criteria during recruitment

Although mentoring programmes can be effective in supporting females to achieve success with promotions, funding and collaborative projects, **other policies and structural processes** are also important to support gender equality in STEM reform.

The gender pay gap (GPG) for those working in STEM industries* in Wales is falling, but remains higher than other industries.



The gender pay gap: has fluctuated between 2011 and 2018. Females earn less than males on average

For **STEM activities** the pay gap has fallen from 33% to **23%** in Wales, but remains higher than the average for all industries (**14%**)

*Using ASHE 'Professional scientific and technical activities' as STEM proxy.

Source: Annual Survey of Hours and Earnings.



Stakeholders' views

30
consulted

Interviewees included:

Members of the Welsh Government's Women in STEM Board, the Board's Education and Industry sub-groups and other interested parties.



These included representatives from the Welsh Government, universities, Further Education, schools, Education Consortia, manufacturing and engineering companies, and third sector organisations promoting STEM and/or gender equality.

Communication and the profile of gender equality in STEM:



An overarching body is needed to co-ordinate STEM activities in Wales.



Welsh Government Ministers and officials with a gender remit need higher profiles.



Accreditation and/or kite marks (e.g. Athena Swan) are important.



Funding of interventions could support activities over longer periods of time.

Delivering effective interventions:



Gatekeepers' knowledge of STEM career pathways need to improve.



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.



Consideration of interventions within schools' competing priorities (e.g. the new curriculum) is important and may provide opportunities.

Effective interventions:



More information about STEM careers is needed in primary schools.



Work experience and practical activities are valuable.



Visible role models are needed in education and society.



Unconscious bias training would benefit those influencing children's decisions.



Society and system change are needed to embed gender equality for all.



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.

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.

There are issues around seniority, childcare, job flexibility – all of these things still need to be addressed – we are still not seeing parity.