Engaging Girls in STE(A)M Careers through Innovation and Problem Solving

Elaine Manton

2018 Churchill Fellow

the CHURCHILL fellowship

Contents

Reader's Guide

This report is designed to be read flexibly. Readers seeking contextual grounding may wish to begin with the Introduction, which outlines the rationale and landscape for the Fellowship.

The core of the report is organised around a series of case studies, followed by cross-cutting themes that synthesise insights across contexts. Findings and implications are discussed throughout, rather than being confined to a single chapter.

Throughout this report, the terms STEM (Science, Technology, Engineering and Mathematics), STEAM (Science, Technology, Engineering, Arts and Mathematics), and STEMM (Science, Technology, Engineering, Mathematics and Medicine) are used where appropriate to reflect different educational, disciplinary, and workforce contexts.

Recommendations for the UK are presented at the end of each case study and thematic section and collated in Appendix A for ease of reference.

Acknowledgements

I would like to express my gratitude to the Churchill Fellowship for funding this research and to the Churchill Fellowship staff for their invaluable support, including their engagement on social media throughout my journey. This project presented me with both a significant challenge and a unique opportunity to enhance my organisational and networking skills. Having never planned a trip of this length or travelled solo for such an extended period, I now feel much more prepared and confident to undertake similar endeavours in the future.

I am grateful to staff at Loreto Grammar School for supporting my project, promoting my project internally and outside of our organisation. Special thanks go to my family, especially my husband Gary and my daughter Alex, whose unwavering support throughout every stage of my research has meant the world to me. Their encouragement and understanding made this journey possible. I can't leave out John Rolfe OBE, for believing I could do this and helping me disseminate through various networks. Most importantly, I would like to extend my heartfelt thanks to everyone who took the time to respond to my emails and calls, and especially to those who met with me to discuss this project. Your insights and willingness to engage are invaluable in advancing STEM opportunities for girls, and I deeply appreciate your commitment to this cause.

About the Author

As a retired teacher now but the former STEM Coordinator and a Specialist Leader of Education at Loreto Grammar School in Altrincham, Cheshire, UK, I am deeply committed to promoting STEM careers to my students. My roles included being a National Expert STEM Teacher, a UK Scientix Ambassador, and a British Council Ambassador. Our school was Teen Tech Centre of Innovation and Creativity Gold standard.

My involvement in European STEM education initiatives has been extensive, and I was honoured to be featured on Euronews as a #Europeanhero for my work in promoting girls into STEM (https://bit.ly/4d553eR). Additionally, our school won the award for STEM School of the Year for the North of England and Scotland, and I personally received the Excellence in STEM Teaching award for the same region for two consecutive years. We were shortlisted for UK STEM School of the Year 2018.

Executive Summary

Between August 2018 and May 2019, the Churchill Fellowship enabled me to undertake a Fellowship exploring how education systems, industry, and innovation ecosystems in Australia and the United States are addressing the persistent underrepresentation of girls and women in STEM and STE(A)M careers. The Fellowship focused on identifying practices, structures, and system-level conditions that successfully support girls' participation, progression, and retention along the STEM pipeline, with a view to informing future practice and policy in the United Kingdom.

While the Fellowship title refers specifically to engaging girls in STE(A)M careers through innovation and problem solving, the findings consistently demonstrate that sustainable change is achieved not by "fixing the girls", but by redesigning the systems around them. The approaches observed benefit all learners, while having a particularly positive impact on girls and other underrepresented groups.

Rationale for visiting Australia and the United States

Australia and the United States were selected due to their international leadership in innovation, STEM education reform, and industry engagement. Australia offers a highly developed vocational education and training (VET) system, characterised by strong employer confidence, applied learning, and clear pathways into skilled employment. The United States, meanwhile, demonstrates scale, diversity, and ecosystem-based approaches to innovation, alongside a growing emphasis on STEAM, entrepreneurship, and real-world problem-solving within education.

Together, these contexts provided rich opportunities to observe how education, industry, and community ecosystems collaborate to address gender inequity in STEM.

Fellowship Approach

This Fellowship was deliberately practice-based rather than academic. It drew on visits to schools, universities, innovation centres, professional networks, industry partners, and community-led initiatives. Evidence was gathered through observation, professional dialogue, and informal and formal conversations with educators, researchers, policymakers, and industry leaders.

The report is structured around a series of case studies, complemented by cross-cutting themes that emerged consistently across settings. Rather than attempting a comparative analysis of national education systems, the report focuses on identifying transferable principles and adaptable models relevant to the UK context.

Key Findings

Across all visits, five interconnected findings emerged:

1. **System design matters more than individual intervention**
The most effective initiatives addressed structural barriers—such as curriculum design, leadership representation, workplace culture, and access to networks—rather than focusing solely on changing girls' attitudes or confidence.

2. **Relevance, integration, and inquiry bring STEM learning to life**
Curricula that emphasise real-world problem solving, interdisciplinary learning, and inquiry-based approaches were consistently more engaging for girls. Programmes that integrated STEM with social purpose, creativity, and agency supported stronger identity formation and sustained engagement.

3. **Mentorship, visibility, and professional networks are critical enablers**
High-impact initiatives consistently included structured mentoring, visible female role models, and strong professional networks spanning education, industry, and research. These networks supported progression, retention, leadership development, and advocacy.

4. **Early and sustained engagement is essential**
Interventions that began in primary education—and continued through secondary, tertiary, and early career stages—were more effective than late-stage interventions alone. Identity, aspiration, and belonging were established early and reinforced over time.

5. **Vocational and industry-aligned pathways strengthen the STEM ecosystem**
Strong vocational pathways, particularly those co-designed with industry, elevated the status of applied STEM learning and created credible, aspirational routes into STEM careers. International examples demonstrated how vocational education can play a central role in widening participation and addressing skills shortages.

Implications for the UK

The UK benefits from strong STEM research, committed educators, and a growing emphasis on technical education through initiatives such as T Levels and University Technical Colleges. However, the Fellowship findings highlight ongoing challenges relating to gender participation, consistency of industry engagement, early intervention, and system-level coordination.

International practice suggests that greater impact will be achieved through aligned ecosystems that connect curriculum, teacher development, industry, vocational pathways, and leadership—rather than through isolated or short-term initiatives.

Headline Recommendations for the UK

Drawing on the full report, the following strategic recommendations are proposed:

- Embed gender equity within national and institutional STEM strategies, treating diversity as a driver of innovation rather than a standalone initiative.
- Invest in early, sustained STEM engagement that supports identity formation from primary education onwards.
- Strengthen curriculum relevance through integrated, inquiry-led, real-world learning across all phases.
- Expand structured mentorship, professional networks, and visible leadership pathways for women in STEM.
- Elevate vocational STEM pathways through sustained industry collaboration, targeted outreach, and long-term investment.
- Move beyond short-term pilots by scaling proven models with demonstrated impact.

Conclusion

At a time when the UK faces significant STEM skills shortages alongside persistent gender inequity, this Fellowship demonstrates how evidence-informed, system-level action can create sustainable change.

Engaging girls in STE(A)M careers requires coherent, system-level action grounded in relevance, inclusion, and purpose. By learning from international practice and adapting these principles within the UK context, there is a significant opportunity to strengthen participation, equity, and innovation across the STEM ecosystem—benefiting individuals, communities, and the wider economy.

Glossary

Australian Academy of Technology and Engineering (ATSE) – Australia's national academy for applied science, technology, and engineering, providing independent expert advice on innovation, industry, and technological capability.

Entrepreneur-in-Residence (EiR) – An industry professional embedded within an educational or organisational setting to support innovation, entrepreneurship, industry engagement, and real-world learning.

Industry Mentoring Network in STEM (IMNIS) – An Australian programme connecting university students with industry mentors to support career development, professional identity, and industry engagement in STEM fields.

National Aeronautics and Space Administration (NASA) – The United States government agency responsible for civil space exploration, aeronautics research, and space science.

Natural Sciences and Engineering Research Council of Canada (NSERC) – Canada's federal agency supporting research and training in the natural sciences and engineering.

New York Academy of Sciences (NYAS) – A global scientific organisation advancing research, education, and innovation through interdisciplinary collaboration and professional programmes.

Order of Australia Medal (OAM) – An Australian honour recognising outstanding service and contribution to the community.

Science, Technology, Engineering and Mathematics (STEM) – An interdisciplinary grouping of academic and professional disciplines focused on scientific inquiry, technological application, engineering design, and mathematical reasoning.

Science, Technology, Engineering, Arts and Mathematics (STEAM) – An extension of STEM that incorporates the arts to emphasise creativity, design thinking, and human-centred problem-solving.

Science, Technology, Engineering, Mathematics and Medicine (STEMM) – A broader classification that includes medical and health sciences within STEM-related education, research, and workforce contexts.

Vocational Education and Training (VET) – Education and training pathways focused on practical skills and industry-aligned qualifications, supporting entry into trades, technical, and applied professional roles.

Women in STEMM Australia (WiSA) – Australia's national peak body advocating for gender equity across science, technology, engineering, mathematics, and medicine.

Introduction

Why Australia and USA?

Between August 2018 and May 2019, the Churchill Fellowship provided me with the opportunity to observe innovative teaching practices in relation to increasing the number of girls opting to study STE(A)M careers after leaving school in Australia and the USA. This experience proved to be one of the most exciting and insightful of my career. During this time, I observed how educators in schools, universities, companies and individuals in these countries were addressing the leaky pipeline in STEM. The objective of the report was to identify methodologies suitable for the UK school system. My approach was not academic. Instead, I aimed to explore as much as possible to generate ideas and find connections between them. Additionally, I sought to look beyond the traditional education system to identify impactful ideas, regardless of their context. Although not all strategies were directly applicable, the research aimed to highlight areas where adaptation could be viable.

There is overwhelming evidence that the UK's digital tech sector is critical to its economic growth. I believe travelling to the countries recognised as leading the way in STE(A)M and Vocational Education and Training (VET) will allow me to develop students' skills to make them better digital citizens, workers, makers, entrepreneurs and gamers to enhance their employability and to help them become economically active. These important digital and entrepreneurial skills were being developed in my school through the integrated STEM curriculum I was allowed to develop through a Computing, Engineering, Design and Technology (CEDT) rotation with Years 8 and 9. My project will address open and innovative practices in a digital era with a focus on inspiring girls into STE(A)M careers. The innovative nature of the project means that it will focus on new approaches to coding and robotics while also addressing engineering and digital skills gaps within the United Kingdom, as well as fostering innovation, which ultimately drives economic growth.

Australia has a very well-developed VET system, which enjoys a high degree of confidence, in particular, engagement of employers is strong. The USA is one of the leading countries in terms of driving innovation and content creation. I wanted to observe how these are integrated into the education systems to enhance my learning and improve my teaching methodologies, particularly in the use of robotics and digital skills within school curriculum. I looked at how each country promoted these skills to girls and how they develop STEM, entrepreneurial and digital skills. I wanted to observe how the idea of adding the arts to STEM programmes has been gaining momentum in the USA. In the same way, VET has a key economic function in upskilling and integrating young people into the labour market in Australia and in providing high quality technical skills. I am keen to see how both systems offer more diverse learning opportunities and greater access to STEM for all types of learners to enable social mobility with reference to bridging the gender and diversity gaps in STEM in the UK.

Addressing the Leaky Pipeline in STEM

The "leaky pipeline" in STEM highlights the issue where individuals, especially women and minorities, leave STEM education and career paths at various stages, reducing workforce diversity. This metaphor emphasises systemic barriers causing attrition throughout the STEM journey, from early education to advanced careers.

Key Factors Contributing to the Leaky STEM Pipeline

Early Education:

- Stereotypes and Biases: Gender stereotypes discourage girls from pursuing STEM.
- Lack of Role Models: Few visible female and minority role models.
- Educational Resources: Inadequate STEM education and resources, particularly in underprivileged areas.

Secondary Education:

- Peer Influence: Social dynamics and peer pressure in coeducational settings.
- Teaching Methods: Traditional methods that do not engage diverse learning styles.

Higher Education:

- Retention Issues: High attrition rates due to lack of support and mentorship.
- Hostile Environments: Non-inclusive or hostile academic and social environments.

Early Career:

- Work-Life Balance: Demanding careers and inflexible work environments.
- Career Advancement: Barriers to advancement, including limited mentorship and discriminatory practices.

Mid to Late Career:

- Lack of Recognition and Support: Challenges in gaining recognition and support.
- Burnout: Persistent pressures and lack of supportive community.

I was really interested in looking at better ways I could engage students, parents, teachers, careers guidance officers, universities and the broader community to demystify and raise awareness of the importance of STEM education and STEM related careers. I wanted to look at addressing these factors and implementing targeted strategies, to find how the STEM pipeline can become more inclusive, allowing a diverse range of individuals to enter, remain, and thrive in STEM fields. While I was particularly looking at girls in STEM, my findings I believe can be adapted to underrepresented minorities in STEM too.

This section summarises the key strengths and challenges of STEM education in the United States, the United Kingdom, and Australia. While all three countries recognise STEM education as essential to economic growth and workforce development, their approaches reflect differing policy frameworks and educational priorities.

United States

STEM education in the United States is underpinned by national and state-level frameworks, notably the Common Core State Standards (CCSS) and the Next Generation Science Standards (NGSS). Policy emphasis is placed on inquiry-led and project-based learning, the development of transferable 21st-century skills, and alignment with workforce and career pathways. Despite these strengths, significant disparities persist in access

to high-quality STEM provision, particularly among underserved and socioeconomically disadvantaged communities.

United Kingdom
In the United Kingdom, STEM education is delivered through a highly centralised national curriculum, characterised by earlier subject specialisation. The system benefits from well-established teacher training and professional development structures, alongside a strong international reputation for STEM research and innovation. However, ongoing funding pressures present challenges for the equitable and consistent implementation of STEM initiatives across schools and regions.

Australia
Australia's national curriculum explicitly embeds STEM disciplines while also recognising Aboriginal and Torres Strait Islander histories and perspectives. National policy places strong emphasis on industry engagement, applied learning, and cultural inclusion within STEM education. Nevertheless, structural challenges remain, particularly in ensuring equitable access to high-quality STEM opportunities for students in rural, regional, and remote communities.

Determining which country is more successful in delivering STEM education involves analysing a range of indicators and considering the unique strengths and challenges of each educational system, which is beyond the scope of this report. All three countries continue to invest in improving STEM education outcomes and preparing students for success in STEM fields, recognising the importance of STEM education in driving economic growth, innovation, and societal development. All three countries aim to prepare students for STEM careers, promote innovation, and address educational equity, but each faces unique challenges in delivering STEM education effectively.

This report is structured around a series of case studies, each accompanied by context-specific recommendations. Cross-cutting themes are identified where common challenges, outcomes, and recommendations emerge across settings, and these are subsequently drawn together to inform the overall findings of the report. For reasons of brevity, the report does not explore in detail differences in education systems, funding models, or governance structures. Instead, it draws on visits to a wide range of settings, including primary and secondary schools, universities, innovation centres, and organisations and businesses with a clear commitment to promoting STEM education.

All roles, titles, and institutional affiliations cited in this report reflect the positions held at the time of travel and engagement. Subsequent changes may have occurred as institutions and programmes have evolved.

Case Studies

1. Changing the Status Quo – A case study with Dr Marguerite Evans-Galea AM

Dr Marguerite Evans-Galea AM is a scientist, executive, and entrepreneur recognised as a Member of the Order of Australia (AM) for her significant contributions to women in STEMM. She is the Executive Director of the Industry Mentoring Network in STEM with the Australian Academy of Technology and Engineering (ATSE) and co-founder and CEO of Women in STEMM Australia (WiSAust). A renowned advocate, she co-chairs the Women in STEMM Australia Board, served on the Science in Australia Gender Equity Expert Advisory Group, and is an Ambassador for the Victorian Honour Roll of Women. Dr Evans-Galea also serves on the inaugural Ministerial Council for Women's Equality in Victoria and actively engages in advisory roles, media communication, and consulting across the STEMM ecosystem.

She currently leads the Australian Academy of Technological Sciences & Engineering (ATSE) initiative the Industry Mentoring Network in STEM (IMNIS www.imnis.org.au), which is a highly effective way to connect young people with senior leaders in STEMM – it breaks down barriers, strengthens skills through mentoring and extends professional networks. It's been very successful at a national level. IMNIS is unique as it fosters a culture of collaboration between industry and academia. Industry-based mentors can act as role models, provide advice on industry-based STEM careers and connect students within this growing sector. IMNIS informs students about the skills needed to work in industry and introduces students to a range of professional STEM careers. Importantly, IMNIS has the potential to strengthen ties and enhance research collaborations between industry and academia, and it also provides direct access to the STEM workforce of the future. As IMNIS Executive Director, Dr Evans-Galea provides operational and strategic oversight of all programmes nationally, engages with new organisations and industry leaders, liaises with key stakeholders and the Expert Advisory Panel, coordinates reporting, communications and marketing, increases the initiative's public profile, and ensures capacity building and sustainability of the national initiative into the future.

IMNIS aims to bridge the gap between academia and industry, foster collaboration and knowledge exchange, and support the professional development of early-career researchers in STEM disciplines.

Women in STEMM Australia (WiSAust) is a volunteer-run non-profit that aims to connect women in STEMM across professional sectors. While they strongly advocate, engage and support girls in STEMM initiatives, they do not run any formal programmes with schools currently. They focus on information sharing, networking and connecting people through symposia, events and social media. It works extremely well to raise awareness and foster an ecosystem that is informed. Many of the group engage with schools and universities, presenting regularly. They run events with a panel of inspiring STEMM professionals who will then connect with all students and parents after the event.

The ATSE is a learned academy that brings together Australia's leading experts in applied science, technology, and engineering to provide impartial, practical, and evidence-based advice on how to achieve sustainable solutions and advance prosperity. The academy is made up of almost 900 Fellows elected by their peers. The academy's new fellows are chosen for their game-changing contributions in fields spanning artificial intelligence, marine biology, photonics, cancer therapy, battery and energy innovation, and more.

"If we want to change outcomes for women in STEM, we must stop trying to 'fix the women' and start redesigning the systems around them."

Marguerite Evans-Galea

Elaine Manton and Dr Marguerite Evans-Galea

Key Recommendations for the UK

Based on Dr Marguerite Evans-Galea's work, here are my three key recommendations for the UK to enhance STEM education and promote gender equity:

1. **Establish Industry–Academia Mentorship Programmes**
   Implement mentorship programmes like IMNIS to connect students with industry leaders. These programmes bridge academia and industry, provide career guidance, enhance skills, and prepare students for diverse STEM careers.

2. **Promote Gender Equity in STEMM**
   Support organisations like Women in STEMM Australia for advocacy, networking, and raising awareness. Such organisations inspire and connect women in STEMM, promoting gender diversity and inclusion.

3. **Increase Public Engagement and Visibility**
   Enhance public engagement through events, symposia, and media. This raises the profile of STEMM professionals, encourages interest in STEMM fields, and fosters collaboration and knowledge exchange.

2. Deeper Learning – A case study in Denver, Colorado with Dr Scott McLeod

Dr Scott McLeod is an educator, speaker, scholar, and advocate, widely known for his blog, "Dangerously Irrelevant", where he shares insights, commentary, and resources related to educational leadership, technology, and innovation. His blog has gained a large following and has been influential in shaping discussions around these topics. He is the author or co-author of several books on educational leadership, technology integration, and school reform. His books include titles such as "What School Leaders Need to Know About Digital Technologies and Social Media" and "Harnessing Technology for Deeper Learning".

He is a passionate advocate for innovation in education and believes in the power of technology to transform teaching and learning. He works to empower educators and school leaders to embrace change, take risks, and create learning experiences that prepare students for success in the 21st century. He emphasises the importance of inclusive pedagogy and curriculum design that engages and supports all students, including girls and young women, in STEM learning. His expertise includes deeper learning, school leadership, technology, and instructional redesign. Through his writing, speaking, and consulting, he has influenced countless educators and administrators to embrace innovative practices and prepare students for the future.

I first came across Dr McLeod through the "Shift Happens" videos which were originally created by Karl Fisch, a technology coordinator in Colorado, as a PowerPoint presentation highlighting global shifts and their implications for education. Fisch's presentation gained traction after he posted it on his blog. In 2007, Scott McLeod mixed Fisch's presentation into a more polished video, adding new elements and enhancements. This remixed version went viral and became a cultural phenomenon, with millions of views and several follow-up versions created over the years. This video was the start of my STEM course when I was STEM Coordinator at Loreto Grammar School. I reached out to meet Dr McLeod when I was in Denver, and he very kindly arranged

"What doesn't work any longer is our education system's stubborn focus on delivering a curriculum that's growing increasingly irrelevant to today's kids… All of that must be rethought. Now."

Scott McLeod

two full days of visits to 5 different types of schools, as well as an innovation centre, which all showed excellent examples of STEM integration and success. These visits provided compelling, real-world examples of effective STEM integration and reinforced the importance of authentic, applied learning experiences in preparing students for future pathways. McLeod's work underscores a central theme of this fellowship: that meaningful STEM education must move beyond traditional curricula to embrace relevance, authenticity, and real-world application.

STEM School Highlands Ranch is a public charter school located in Highlands Ranch, Colorado, United States. It focuses on providing education in the fields of (STEM), hence the name. The school emphasises hands-on learning and aims to prepare students for careers in STEM-related fields or further education in STEM disciplines. Like many charter schools, STEM School Highlands Ranch operates independently of the local school district, allowing for more flexibility in its curriculum and educational approach. STEM School Highlands Ranch offers a variety of STEM-focused courses and extracurricular activities, including robotics, computer programming, engineering, and advanced mathematics. The curriculum is designed to be rigorous and challenging, with an emphasis on critical thinking, problem-solving, and collaboration.

The school often participates in STEM competitions and events, both locally and nationally, allowing students to showcase their skills and knowledge in various STEM disciplines. Additionally, STEM School Highlands Ranch promotes a culture of innovation and creativity, encouraging students to think outside the box and pursue their interests in STEM. It does this through a specialised curriculum, numerous extracurricular activities related to STEM fields, partnerships with STEM organisations, STEM competitions, integration of technology and by having dedicated STEM facilities.

Elaine Manton and Dr Gregg Cannady
Director of Collaboration and Concept Development, STEM School Highlands Ranch

Wheat Ridge High School, located in Wheat Ridge, Colorado, is a public high school known for its comprehensive educational programmes and strong emphasis on student achievement and community involvement. Their partnerships showcase a successful integration of high school STEM education with real-world applications, preparing students for future endeavours. Their strengths include their academic programmes, which offer specialised courses and extracurricular activities in STEM education; community partnerships achieved by collaborating with local businesses, colleges, and organisations to enrich student opportunities and to foster civic responsibility; and community engagement realised through internships and apprenticeships, guest speakers and workshops. They are recognised for academic excellence, high graduation rates, and success in competitions. The school is STEM focused, with robotics teams that compete in design and build challenges, it encourages research projects and presentations through science fairs, and collaborates with universities and companies for additional STEM opportunities. These initiatives cultivate a well-rounded

education, preparing students for future success. While I was there, I learnt about a programme, in collaboration with the University of Colorado Denver, which was constructing two hydrogen fuel cell cars for the 2017-18 academic year: a prototype vehicle and an urban concept vehicle.

Elaine Manton with Chuck Sprague and Shell Eco-marathon students Wheat Ridge High School

Lakewood High School, located in Lakewood, Colorado, a suburb of Denver.

Lakewood High School (LHS) is one of the largest high schools in the state and serves a diverse student population. The school offers an academically robust curriculum for students who are college bound as well as a variety of other academic programmes to meet the needs and interests of all their students. Very much like Wheatridge, LHS is equipped with the latest in educational technology, has a strong tradition of community support and the student population comes from a wide variety of ethnic, academic, economic and geographic backgrounds.

In 2013, the National Aeronautics and Space Administration (NASA) invited Matthew Brown and his students to participate in its High School Students United with NASA to Create Hardware (HUNCH) program, through which NASA partners with schools to help students develop and test NASA-aimed items such as hardware and soft goods (https://nasahunch.com/). The HUNCH mission is to empower and inspire students through a Project Based Learning programme where high school students learn 21st-century skills and can launch their careers through the participation in the design and fabrication of real-world valued products for NASA.

> ''Our kids can put on their résumé that they designed and built an experiment that flew on the International Space Station.''
>
> *Matthew Brown, Lakewood High School*

Elaine Manton with Matthew Brown Lakewood High School

Ryan Elementary STEAM School is the only STEAM school within Boulder Valley School District.

This dynamic learning community offers a whole-child focus on learning fundamentals. Located in Lafayette, Colorado, alongside a huge STEAM focus they offer Project Based Learning within every grade level, as well as opportunities for students to experience nature and the outdoors within the Boulder County Community. Through their 'STEAM Focus' they emphasise creativity, critical thinking, problem-solving, and innovation by integrating arts with traditional STEM subjects. Their hands-on, inquiry-based learning experiences and project-based activities connect classroom learning to real-world applications. They combine academic rigor with creativity, preparing students for success in a technology-driven world. They strongly believe that partnerships nurture excellence and therefore they partner with a variety of community organisations.

Elaine Manton with Dr Scott McLeod and Katie Gambardella
Ryan Elementary School, Lafayette

Classroom discussion with staff member
Ryan Elementary School, Lafayette

Trail Ridge Middle School

Trail Ridge Middle School (TRMS) is a STEM Focus school which focuses on the Design Thinking Process and integrating STEM throughout the day. It is a part of the St. Vrain Valley School District, where academic excellence is by design! They are nationally recognised as an Apple Distinguished School for their robust technology integration and learning supports. They strive to prepare students for a future where innovation, communication, collaboration, global competency, critical thinking, and problem-solving will be essential. Their diverse setting offers a great chance for students to collaborate with others, and their business partnerships provide a unique opportunity for students to interact with the 'real world'.

The final institution I visited was the **St. Vrain Valley School District (SVVSD) Innovation Center**, which is discussed later in this report, in the section Strategies and Themes

System-Level Enablers: From Bits to Atoms.

Across the schools visited, several consistent features were evident that supported high-quality STEM education and successful student outcomes. All schools had well-equipped technology centres facilitating robotics, electronics, and computational projects, alongside dedicated engineering spaces that enabled hands-on, applied learning. These spaces provided access to industry-standard tools and technologies, including 3D printers, laser cutters, CNC machines, basic hand tools, and prototyping equipment.

In addition, each setting incorporated purposefully designed collaborative learning areas that supported teamwork, discussion, and problem-solving. These flexible environments typically featured movable furniture and multimedia facilities to enable presentation, reflection, and shared learning. Importantly, these physical environments were not standalone assets; they were embedded within curricula that deliberately integrated STEM learning with real-world applications, thereby preparing students for future academic study, employment, and innovation-focused pathways.

Key Recommendations for the UK

1. **Invest in Flexible, Industry-Aligned STEM Learning Environments**
   Prioritise the development of well-equipped STEM spaces that integrate engineering, technology, and collaborative learning, aligned with curriculum goals and real-world applications.
2. **Embed Project-Based and Design-Led STEM Learning Across School Phases**
   Strengthen the use of project-based learning and design thinking approaches that promote problem-solving, creativity, and applied STEM skills from primary through secondary education.
3. **Strengthen Partnerships Between Schools, Industry, and Higher Education**
   Expand sustained partnerships that provide students with access to mentors, competitions, internships, and authentic STEM projects, supporting progression into further study and STEM careers.

3. 1000 Girls, 1000 Futures – A case study with NYAS

The New York Academy of Sciences (NYAS) is an independent, nonprofit organisation that was established in 1817 with a mission to advance scientific research, education, and policy. The organisation operates various programmes and initiatives aimed at promoting science education, fostering scientific collaboration, and addressing global challenges through science and technology.

NYAS offers a range of student programmes aimed at fostering interest and participation in (STEM) fields among young people. These programmes provide opportunities for students to engage in authentic hands-on learning experiences, mentorship, research projects, and networking with peers and professionals. Some of the notable student programmes offered by NYAS are:

1000 Girls, 1000 Futures: Empowers young women globally in STEM with mentorship and skill-building.

Global STEM Alliance (GSA): A network offering mentorship, virtual challenges, and professional development.

Junior Academy: A virtual platform for students aged 13-17 to work on global STEM challenges with mentors.

After School STEM Mentoring: Pairs high school students with graduate mentors for hands-on STEM activities.

STEM Camps and Workshops: Provides hands-on STEM exploration and professional interaction throughout the year.

Science Education Pipeline (SEP): Supports underserved NYC students with STEM resources and mentorship to increase diversity.

Virtual Learning Opportunities: Offers webinars, courses, and resources on various STEM topics for global access.

I was particularly interested in learning more about the *1000 Girls, 1000 Futures* programme, in which my students had previously participated. Following my visit, I undertook professional development and completed the **New York Academy of Sciences Certified STEM Educator** programme, which further informed my understanding of research-informed approaches to STEM education, mentoring, and progression pathways for underrepresented groups.

1000 Girls, 1000 Futures programme is an initiative by the New York Academy of Sciences' Global STEM Alliance (GSA) that aims to engage and inspire young women interested in STEM fields and advance their pursuit of STEM careers through mentoring and 21st-century skills development. The programme is modelled as a 1:1 mentorship opportunity in which young women aged 13-19 are paired with female STEM professionals working across the globe. Through this unique opportunity, each girl is matched with a mentor who shares similar research interests and together they design a curriculum that works for them.

Key features include:

Mentorship: Participants are paired with female STEM professionals for personalised guidance and support.

Online Learning Platform: Access to STEM coursework, workshops, and discussions with peers and mentors globally.

Community Engagement: A global community for networking, exchanging ideas, and celebrating achievements.

Skill-Building Activities: Workshops and projects to enhance STEM knowledge, critical thinking, and leadership skills.

Career Exploration: Exposure to diverse STEM career paths and real-world applications.

By providing mentorship, resources, and opportunities for growth, the programme seeks to create a more diverse and inclusive STEM community that reflects the talent and potential of girls around the world.

Elaine Manton with Kaari Casey, Program Manager, The Junior Academy

Key Recommendations for the UK

1. **Expand Mentorship Programmes for Young Women in STEM**
   Implement mentorship programmes similar to NYAS's 1000 Girls, 1000 Futures, pairing young women with female STEM professionals. Mentorship boosts confidence, provides role models, and enhances career insights, promoting gender diversity in STEM.
2. **Promote STEM Diversity and Inclusion Initiatives**
   Launch initiatives to increase diversity in STEM, including scholarships and diversity-focused programmes. Targeted support increases diversity and ensures all students have opportunities to succeed in STEM.

4. Gender Diversity in STEM – Professor Elizabeth Croft

Professor Elizabeth Croft is an internationally recognised academic leader in robotics, human–robot interaction, and engineering education, with a strong record of advancing gender equity in STEM. Her work spans senior academic leadership, research excellence, and the design of initiatives that support the participation and progression of women in engineering and technology, contributing to measurable improvements in gender representation within engineering faculties.

During her tenure as Natural Sciences and Engineering Research Council of Canada (NSERC) Chair for Women in Science and Engineering (2010–2015) and as Associate Dean at the University of British Columbia (UBC), female enrolment in engineering increased to approximately 30%. In these roles, she provided strategic oversight of equity initiatives, influenced faculty policy and culture, and embedded gender inclusion within engineering education and professional development structures. She also founded Westcoast Women in Engineering, Science, and Technology (WWEST), a collaborative programme working with industry and non-profit partners to promote women's engagement and success across STEM disciplines.

Before joining Monash University, Professor Croft served as Professor of Mechanical Engineering and Associate Dean of Education and Professional Development at UBC. In these positions, she played a key role in curriculum development, staff development, and institutional policy, with a sustained focus on inclusive educational practice. Her research in human–robot interaction complements this work, particularly in exploring how emerging technologies can be designed to be inclusive, ethical, and human-centred.

Alongside her academic leadership, Professor Croft is a visible and respected advocate for gender equity in STEM, contributing regularly to national and international conferences, advisory groups, and public forums. Her work consistently links diversity with innovation, excellence, and societal impact, reinforcing the importance of systemic and evidence-informed approaches to change.

Key Recommendations for the UK

Based on Professor Elizabeth Croft's work, the following recommendations are proposed for the UK:

1. **Embed Gender Equity within Senior Academic Leadership**
   Support senior leadership roles with explicit responsibility for advancing gender equity in STEM, ensuring inclusion is embedded within institutional governance, policy, and strategic decision-making.
2. **Develop Sustained Mentorship and Industry-Engaged Networks**

Establish mentoring and networking programmes that connect students and early-career professionals with academic and industry leaders, supporting progression, retention, and visibility for women in STEM.

3. **Align Research, Policy, and Inclusive Educational Practice**
   Invest in research-informed policy development and inclusive curriculum design, alongside targeted initiatives that encourage girls and young women to engage with STEM education and careers.

Elaine Manton with Professor Elizabeth Croft

"That dynamic of diversity – gender diversity, age diversity and ethnic diversity – is actually a great driver of innovation in the way projects are thought about."

Elizabeth Croft

5. Innovation – Great Minds Don't Think Alike: Building STEM Ecosystems Through Collaboration. A case study of Dr Jenine Beekhuyzen, with linked practice from Dr Linda Pfeiffer

Dr Jenine Beekhuyzen is a leading voice in efforts to increase gender diversity in STEM and is widely recognised for her work empowering girls and women to pursue opportunities in technology and innovation. Through her leadership of the Tech Girls Movement Foundation, she has had a significant impact on inspiring the next generation of female leaders in STEM. Her contribution has been recognised nationally and internationally, including the award of the Order of Australia Medal (OAM) for significant service to the community in promoting gender equality in technology and education.

Dr Beekhuyzen is the founder and CEO of the Tech Girls Movement Foundation, a non-profit organisation dedicated to promoting STEM education and encouraging girls to see technology as a tool for social good. The Foundation delivers initiatives such as the *Search for the Next Tech Girl Superhero* competition and provides accessible resources, mentoring, and hands-on learning opportunities. Over the past decade, these programmes have engaged more than 14,000 girls, delivering over 100,000 hours of digital technology learning. Central to this work is the belief that young people should be supported to solve problems they care about within their own communities, fostering both technical capability and civic engagement.

Alongside programme delivery, Dr Beekhuyzen is an accomplished author and communicator. Her books, including *Tech Girls Are Superheroes* and *Tech Girls Are Chic*, are designed to inspire girls while also supporting educators and parents to better understand pathways into technology and STEM careers. She is also a highly

sought-after educator and speaker, regularly presenting at conferences, schools, and public events on gender equity, digital literacy, and inclusive technology education. Her work has been recognised through numerous awards, including being named one of the Australian Financial Review's 100 Women of Influence.

Linked Practice During Australian Science Week

During Australian Science Week 2018, two separate meetings arranged in Brisbane unexpectedly converged in the same location, highlighting the collaborative nature of the STEM ecosystem in practice. At this event, Dr Beekhuyzen was delivering a primary-focused workshop alongside Dr Linda Pfeiffer, providing an opportunity to observe the intersection of national advocacy, community engagement, and university-led STEM infrastructure.

Dr Linda Pfeiffer is a Senior Lecturer in the School of Education and the Arts at Central Queensland University (CQU), based at the Gladstone Marina campus. She is the Australia Pacific LNG (APLNG) STEM Research Central project lead and coordinates science and STEM units across undergraduate and postgraduate primary and early childhood education programmes. Her work spans industry, community groups, and schools, with the aim of improving STEM outcomes across all sectors. Dr Pfeiffer has received significant recognition for her work, including the 2016 Women in STEM Research Prize, and has secured more than $1.2 million in external funding. Her research and practice extend across virtual reality, agriculture, robotics, marine ecology, and applied sciences.

At the time of the visit, Dr Pfeiffer was leading the development of CQU STEM Central at the Gladstone Marina campus. The facility was conceived as a flexible, community-facing STEM hub, comprising seven interchangeable zones: electrical, robotics, mathematics, dark room, coding laboratory, wet booth, and a generic teaching space. The design reflects a strong commitment to adaptability, inclusivity, and hands-on learning across age groups and community sectors.

At the opening ceremony, CQU Vice-Chancellor Professor Scott Bowman emphasised the role of the facility in building local STEM capacity and confidence, while Dr Pfeiffer highlighted its intended use by a wide range of community groups, including Indigenous communities, early years learners, young people, seniors, disability services, and multicultural groups. Together, the work of Dr Beekhuyzen and Dr Pfeiffer illustrates how national advocacy, community-based programmes, and university-led infrastructure can align to support sustained engagement in STEM.

Key Recommendations for the UK

1. **Introduce Early, Purpose-Driven STEM Engagement**
   Provide girls with early exposure to STEM through hands-on, community-connected programmes that emphasise technology for social good.
2. **Strengthen Access to Visible Role Models and Mentors**
   Promote diverse female role models in STEM and develop mentoring opportunities that support girls at key transition points in education.
3. **Develop Relevant and Relatable STEM Content**
   Ensure curricula and resources connect STEM learning to real-world issues and experiences that are meaningful to girls and their communities.

4. **Create Supportive Ecosystems Across School, Home, and Community**
   Foster environments that actively encourage girls to explore, question, and persist in STEM, supported by educators, families, industry, and community partners.

"We all have a superpower… especially young girls, who can create their own future by using technology to solve real problems."

Jenine Beekhuyzen

"It is so important to provide a link between the STEM experts in their fields and children, teachers and the wider community."

Linda Pfeiffer

Elaine Manton with Dr Jenine Beekhuyzen and Dr Linda Pfeiffer

6. Girls for a Change – A case study with Tara Chklovski

Tara Chklovski is a leading figure in technology education and women's empowerment, best known as the founder of Technovation, a global non-profit established in 2006 to address gender inequity in STEM. With a background in computer science, she has developed a scalable, community-based model that supports girls and families to become active participants and leaders in technology and engineering.

Under her leadership, Technovation has expanded to reach thousands of girls across more than 100 countries. Its flagship programme, the Technovation Challenge, enables girls to identify real-world problems within their communities and develop technology-based solutions, most commonly through mobile applications. The programme is supported by a global volunteer mentor network and local chapters, enabling adaptation to diverse cultural and educational contexts while maintaining a consistent learning framework.

Chklovski's approach combines hands-on, project-based learning with sustained mentorship and access to free, research-informed educational resources. Central to the Technovation model is the formation of small teams supported by industry and community mentors, alongside engagement with local leaders to ensure relevance and long-term impact. This structure promotes collaboration, confidence, and agency, while also strengthening links between education, industry, and community contexts.

Alongside programme delivery, Chklovski is a visible advocate for girls' participation in engineering, robotics, and emerging technologies. Her work emphasises responsible and ethical approaches to technology, including artificial intelligence, with a strong focus on equity, global access, and the importance of highlighting effective, scalable programme models. Through international advocacy, media engagement, and partnership-building, she has contributed to increased visibility of girls as creators and leaders in STEM.

Elaine Manton with Tara Chklovski

"We can replicate the kind of inspiration I found to empower girls by showcasing just how many ways engineering and robotics can impact their lives and communities while also promoting gender equality in these fields and adequately displaying how women are making a difference in STEM."

Tara Chklovski

Key Recommendations for the UK

1. **Adopt Project-Based, Real-World STEM Learning Models**
   Integrate project-based programmes that enable girls to address real community challenges through technology, supporting engagement, relevance, and skills development.
2. **Scale Mentorship-Led, Community-Embedded Programmes**
   Develop and support mentoring models that connect girls with industry volunteers and local partners, ensuring programmes are adaptable to local contexts while benefiting from national coordination.
3. **Promote Equity, Ethical Technology, and Global Perspectives in STEM Education**
   Embed equity, responsible technology use, and global citizenship within STEM curricula and initiatives, drawing on evidence-based models that have demonstrated impact at scale.

7. Fix the System, Not the Girls – A case study with Sarah Moran, Girl Geek Academy

A recurring theme across the fellowship was the need to move beyond deficit models that focus on "fixing" girls and women, and instead address the systemic barriers embedded within STEM education and workplaces. This perspective was articulated particularly clearly in the work of Sarah Moran, co-founder and CEO of Girl Geek Academy in Australia.

Reflecting on national STEM policy initiatives, Moran welcomed the intent of long-term government strategies, noting that *"gender equality is something that both sides of government understand is an issue, so to see these initiatives go one step further is really important."* However, she cautioned that progress will remain limited unless attention shifts to workplace culture and structural reform. *"There's no point pushing women and girls into a pipeline that's already broken,"* she argues. From Moran's perspective, the decline in gender equity in technology is not due to a lack of evaluation or understanding of what works, but rather a persistent failure to invest at scale in proven solutions.

This position was reinforced by evidence gathered by Girl Geek Academy through a survey of more than 300 women, men, and gender-diverse people working in technology, submitted to Minister Ed Husic's Diversity in STEM review. The findings echoed a consistent message: enough talk—what is now required is sustained, strategic investment in systemic change.

Founded in 2014 by Moran and COO Tammy Butow, Girl Geek Academy operates as a social enterprise with an explicit mission to address structural inequities across the technology ecosystem. Its ambition—to bring one million women and girls into technology careers by 2030—is pursued through interventions that span education, workforce development, industry engagement, and policy influence. Programmes target

participants from early childhood through to adult career changers, reflecting a lifecycle approach rather than a narrow pipeline model.

Under Moran's leadership, Girl Geek Academy has pioneered globally recognised initiatives, including the world's first hackathon for women (#SheHacks), large-scale teacher professional development supporting Australia's Digital Technologies Curriculum, middle-grade STEM fiction published with Penguin Random House, and—most recently—a national AI learning community for over 2,000 high school girls developed in partnership with Microsoft. These initiatives deliberately combine skills development with visibility, community-building, and cultural change. She said *"Working to shift the way political leaders, schools, young girls and professional women think about and practice STEM, Girl Geek Academy is for girls from the age of 5 right through to 95!"*

Crucially, Girl Geek Academy's work illustrates that improving participation requires reshaping systems, not simply increasing entry points. By engaging families, schools, educators, employers, and policymakers simultaneously, Moran's approach reframes gender equity in STEM as a shared responsibility rather than an individual burden placed on girls and women.

Key Recommendations for the UK

1. **Inclusive Workplace Reform**
   Invest in sector-wide initiatives that address workplace culture, progression pathways, and retention in technology and STEM industries, rather than focusing solely on recruitment.
2. **Sustained Investment in Proven Models**
   Move beyond pilot programmes and short-term funding cycles to scale initiatives that have demonstrated impact in engaging and retaining women in STEM.
3. **Ecosystem-Based Approaches**
   Support community-led networks, similar to Girl Geek Academy, that operate across education, industry, and policy, recognising that lasting change requires coordinated, system-level action.

"It's not about 'fixing' the girls and women; it's about fixing the system that works to exclude them and continues to push them out."

Sarah Moran

Elaine Manton with Sarah Moran

8. Mother Nature Needs Her Daughters – Fabian Dattner

Networks Are Key to Advancing Women in STEMM

A report by the **Asia Foundation**, *Accelerating Women's Advancement in STEM: Emerging Lessons on Network Strategies and Approaches* (June 2021), highlights the critical role that women's STEMM networks play in overcoming barriers and advancing opportunities for women and girls. The report demonstrates that effective networks create and sustain safe spaces for sharing, mentorship, visibility, and peer support, enabling women to navigate systemic challenges across education, research, and industry.

One powerful example of this in practice is **Homeward Bound**, a global leadership initiative for women in science.

Fabian Dattner, an Australian leadership expert, entrepreneur, and advocate for gender equality, is best known for her role in co-founding Homeward Bound. Established in 2016 with Dr Jessica Melbourne-Thomas, a marine ecologist, the initiative emerged from two urgent and interconnected challenges: the climate crisis and the persistent underrepresentation of women in scientific leadership. Dattner recognised that increasing the influence of women in science—particularly in climate-related fields—was not only an equity issue, but a global necessity.

Homeward Bound is a year-long leadership programme designed to build capability, confidence, and global networks among women working across STEMM. The programme brings together participants from diverse scientific and professional backgrounds, including researchers, educators, policymakers, and industry leaders. Through intensive leadership development focused on communication, collaboration, strategic thinking, and systems leadership, participants are equipped to drive meaningful change within their organisations and across broader scientific and societal contexts.

A defining feature of Homeward Bound is its culminating expedition to Antarctica. This immersive experience enables participants to witness the impacts of climate change firsthand while working collaboratively across disciplines. The expedition is both symbolic and practical, reinforcing the urgency of global cooperation and the importance of diverse leadership in addressing complex, planetary challenges.

Since its inception, Homeward Bound has gained significant international recognition, with hundreds of women from over 80 countries participating across multiple cohorts. The initiative has evolved into a powerful global network, amplifying women's voices in scientific and leadership spaces that have traditionally been male dominated.

Crucially, the programme addresses a persistent challenge for many women in STEMM: visibility. Women frequently report discomfort with self-promotion and networking, despite the well-documented importance of visibility for leadership progression. Homeward Bound explicitly supports participants in developing strategies for professional presence and influence—described within the programme as learning *"how to be visible without vanity."* This reframing is central to enabling women to step into leadership roles while remaining authentic, values-driven, and connected to their purpose.

Key Recommendations for the UK

1. **Establish and Sustain Women in STEMM Networks**
   Support the development of formal and informal women's STEMM networks across education, research, and industry. Provide long-term funding and structural support to ensure these networks can

offer mentorship, peer support, collaboration opportunities, and safe spaces for sharing experiences and navigating systemic challenges.

2. **Invest in Leadership Development with a Focus on Visibility**
   Expand leadership development programmes specifically designed for women in STEMM, with a strong emphasis on communication, strategic influence, and professional visibility. Programmes should explicitly address confidence, networking, and progression, supporting women to navigate leadership pathways effectively and authentically.

By prioritising networks, leadership development, and visibility, the UK can strengthen the participation and progression of women in STEMM, driving innovation, equity, and long-term impact across science, technology, and society.

"Men network more effectively to advance their careers and influence… the issue of visibility very rarely causes men grief — they accept, understand it, it goes with the territory, it's not seen as ego."

Fabian Dattner

Elaine Manton with Fabian Dattner

9. Creating Robots That See – A case study with Dr Sue Keay

Dr Sue Keay is a respected global leader in robotics and artificial intelligence and is widely acknowledged as one of Queensland's most influential people. She is the Founder and Chair of the Robotics Australia Group, an Adjunct Professor at Queensland University of Technology (QUT), and a trusted adviser on national technology policy, including Australia's National Robotics Strategy.

Dr Keay is known for leading high-impact, integrity-driven enterprises at the intersection of research, industry, and government. She established the Australian Centre for Robotic Vision and led the development of Australia's first and second national robotics roadmaps, providing strategic direction for the country's robotics and AI ecosystem. Her work has been instrumental in positioning robotics as a national capability critical to productivity, resilience, and future workforce development.

Alongside her technical leadership, Dr Keay is deeply committed to diversity, equity, and inclusion in technology. She represents Oceania for Women in Robotics and played a pivotal role in bringing the Grace Hopper Celebration—the world's largest gathering of women in technology—to Australia. Through these roles, she has consistently elevated women's voices, visibility, and leadership in robotics and AI.

Dr Keay's contribution to advancing women in STEM is multifaceted, spanning advocacy, mentorship, leadership, education, research, and policy. Rather than focusing on a single intervention, her

approach addresses the entire ecosystem, supporting women at multiple stages of their careers while challenging the structural barriers that limit progression.

Advocacy and Awareness

Dr Keay is a highly visible advocate for gender diversity in STEM. Through public speaking, media engagement, and conference leadership, she regularly highlights the importance of inclusive technology development and the risks of excluding women from shaping AI and robotics futures. She also contributes articles and opinion pieces that combine evidence-based analysis with practical recommendations, helping to influence both public discourse and organisational practice.

Mentorship and Networks

Mentorship is central to Dr Keay's impact. She actively mentors women across academia, industry, and entrepreneurship, offering guidance on career progression, leadership, and navigating male-dominated technical fields. She also supports the creation and strengthening of networks for women in STEM, recognising that peer connection, shared experience, and sponsorship are critical for retention and advancement.

Leadership and Organisational Change

In senior leadership roles—including at CSIRO's Data61 and the Queensland AI Hub—Dr Keay has implemented diversity and inclusion initiatives aimed at creating equitable workplaces. These include inclusive recruitment practices, leadership development, and organisational cultures that support flexibility and progression. Her leadership demonstrates how systemic change can be embedded within high-performance technology organisations.

Education, Outreach and Role Modelling

Dr Keay strongly advocates for early and sustained engagement of girls in STEM. She supports education and outreach initiatives that make robotics and AI accessible, relevant, and inspiring to young people. Through her visibility as a technologist and leader, she acts as a powerful role model, helping girls and young women see themselves as future engineers, roboticists, and AI leaders.

Research and Policy Influence

Dr Keay supports and promotes research into gender diversity in STEM, using data to identify barriers and inform solutions. At a policy level, she advocates for systemic reforms—including flexible working, parental leave, and bias-aware practices—that enable women to thrive in technical careers. Her influence on national strategy highlights the importance of embedding gender equity within innovation and workforce planning.

Elaine Manton with Dr Sue Keay

"If we don't have diverse people designing and building our technologies, we risk embedding bias into the systems that will shape our future."

Sue Keay

Key Recommendations for the UK

1. **Implement Integrated Mentorship and Networking Frameworks**
   Establish national and regional mentorship programmes for women in STEM, linked to strong professional networks. These should support women across career stages—education, early career, leadership, and entrepreneurship—providing guidance, sponsorship, and peer support.
2. **Embed Gender Equity in STEM Policy and Leadership**
   Strengthen advocacy and policy action to address systemic barriers, including flexible working arrangements, parental leave, and bias-aware recruitment and promotion practices. Gender equity should be embedded within national AI, robotics, and innovation strategies, not treated as an add-on.
3. **Strengthen Early Engagement and Visible Role Models in STEM**
   Expand STEM education and outreach initiatives that engage girls from an early age, particularly in emerging fields such as AI and robotics. Invest in visible female role models who reflect diverse pathways and backgrounds, helping girls to imagine themselves as future leaders in technology.

As I moved between institutions, programmes, and national initiatives during my Churchill Fellowship, it became increasingly clear that the most effective approaches to advancing women in STEM were not isolated or accidental. Across Australia and the United States, common strategies emerged, regardless of setting or sector. These recurring themes provide valuable insight into how systems can be designed to better support diversity, inclusion, and innovation in STEM. The following section synthesises these themes and explores their relevance for the UK context.

Strategies and Themes

System-Level Enablers: From Bits to Atoms

While the preceding case studies highlight individuals and programmes addressing gender inequity in STEM, my visit to Massachusetts Institute of Technology (MIT) and engagement with Sherry Lassiter revealed the infrastructures that enable such initiatives to flourish, scale, and endure. While this engagement provided a foundational understanding, further examples from industry and public education illustrate how these principles operate across different contexts.

Enabling Innovation Ecosystems: Digital Fabrication, Access, and Agency

A significant element of my Fellowship was engagement with Sherry Lassiter, President and CEO of the Fab Foundation and Director of the global Fab Lab Program originating from MIT's Center for Bits and Atoms (CBA). This included a virtual meeting during my visit to Boston, followed by a rare, non-public visit to the Center for Bits and Atoms—an opportunity not typically accessible to external visitors.

Lassiter is a principal architect of the global Fab Lab movement, which has expanded to over 1,800 digital fabrication laboratories across more than 100 countries. Emerging from CBA, Fab Labs function as community-based hubs equipped with advanced digital fabrication tools, including 3D printers, laser cutters, and CNC machines. Their purpose extends beyond technical skill development to enabling grassroots innovation,

entrepreneurship, and locally driven problem-solving, particularly in underserved and marginalised communities.

Central to this model is the idea that *"bits become atoms"*—that computational ideas are transformed into physical artefacts through making, experimentation, and iteration. This approach demands deep engagement with mathematics, science, engineering, and design, while reframing STEM as a practical, creative, and socially relevant endeavour. For girls and other underrepresented groups, this reframing is particularly powerful, as relevance, identity, and purpose are critical to sustained engagement.

During my visit to the Center for Bits and Atoms, I observed how interdisciplinary research and educational practice are deliberately intertwined. While CBA itself does not operate gender-specific programmes, its commitment to openness, accessibility, and hands-on learning establishes the structural conditions in which more diverse participation becomes possible. This ecosystem is complemented by targeted initiatives such as MIT's Women's Technology Program (WTP), which demonstrates how focused interventions can sit within—and be strengthened by—broader enabling infrastructures.

Together, the work of Lassiter, the Fab Foundation, and MIT illustrates how systemic investment in access, tools, and learning environments can shift who participates in STEM, how they engage, and what futures become possible. Rather than "fixing the girls," this approach focuses on fixing the system.

Industry Platforms as Enablers: Autodesk and Access to Professional STEM Tools

Industry platforms play a critical role in shaping who participates in STEM and how early technical identity is formed. Autodesk provides a clear example of how access to widely adopted professional tools can create continuity between school-based learning, vocational pathways, and STEM careers.

Autodesk's design and engineering software is widely embedded across secondary, further, and higher education. For students—particularly girls—working with professional tools enables learning to feel authentic, relevant, and future-facing, rather than abstract or simulated.

Beyond access, Autodesk has articulated explicit commitments to diversity and inclusion through initiatives supported by the Autodesk Foundation and partnerships with organisations such as Girls Who Code and TechWomen. These efforts reinforce the message that women belong along the full STEM innovation and leadership pipeline, not solely at entry level.

Autodesk's role illustrates how industry engagement can function as a system-level enabler, strengthening pathways, normalising participation, and reinforcing the relevance of STEM learning to real-world careers.

Public Education as an Innovation Ecosystem: St. Vrain Valley School District

Building on the research-led infrastructure of MIT and the industry platforms exemplified by Autodesk, the St. Vrain Valley School District (SVVSD) Innovation Center demonstrates how system-level enablers can be translated into public education at scale.

The SVVSD Innovation Center operates as a catalyst and connector between schools, industry, higher education, and the wider community. Embedded within the district's educational strategy, it provides authentic, project-based learning experiences that integrate emerging technologies as tools for engaging with complex, interdisciplinary challenges.

A defining strength of the model is its sustained partnership with external organisations, offering students access to mentors, industry-standard tools, and real-world problems. For girls and underrepresented learners,

this exposure helps sustain engagement at critical transition points where the STEM pipeline is most vulnerable.

Equally important is the Center's role in professional learning. By building educator capacity across the district, innovation is not confined to a single site or dependent on individual champions. This emphasis on scalability and sustainability addresses a persistent weakness in many equity-driven STEM initiatives.

The SVVSD Innovation Center illustrates how public education systems can move beyond isolated interventions towards fully integrated innovation ecosystems that connect learning with purpose, relevance, and future opportunity.

These system-level enablers provide critical context for the thematic analysis that follows.

Themes

Theme 1: Diversity Drives Innovation

Across Australia and the United States, consistent evidence emerged that diversity functions as a catalyst for innovation rather than a peripheral equity concern. This relationship was demonstrated across national policy frameworks, institutional leadership, professional networks, and industry-led initiatives, with diversity repeatedly linked to improved decision-making, organisational performance, and innovation capacity across STEMM disciplines.

At a national policy level, the work of **Marguerite Evans-Galea** through Science in Australia Gender Equity (SAGE) illustrates how structured equity frameworks can drive systemic transformation. As a member of the SAGE Expert Advisory Group, Dr Evans-Galea contributed to adapting the UK's Athena SWAN Charter for the Australian context, embedding accountability, self-assessment, and action planning across universities and research institutions. This approach positions gender equity as integral to research excellence, talent attraction, and institutional sustainability, reinforcing the link between diversity and organisational performance.

Leadership visibility emerged as a second critical mechanism through which diversity translates into innovation. Through my discussion with Dr Evans-Galea, the role of **Lisa Harvey-Smith**, Australia's Women in STEM Ambassador, was highlighted as a federally funded intervention designed to normalise diversity in STEM leadership. Harvey-Smith's public profile—particularly as an openly LGBTQI woman in STEM—demonstrates how visible leadership can challenge stereotypes, broaden aspirations, and influence participation along the pipeline.

Professional networks were repeatedly identified as essential infrastructures for converting diversity into sustained innovation. The work of **Women in STEMM Australia**, described by Dr Evans-Galea, illustrates how networks amplify impact when they intentionally integrate diverse perspectives. Drawing on affiliates that include Indigenous advisors, gender equity specialists, LGBTQI leadership, early-career researchers, and doctoral candidates, the network ensures that policy influence and public messaging reflect a broad range of lived experiences**. Sarah Chapman**, Co-Chair of Women in STEMM Australia and Adjunct at James Cook University, emphasises her commitment to advancing inclusion and equity in STEM, particularly through supporting regional education and underrepresented groups. While I was unable to meet directly with **Lisa Harvey-Smith** or **Sarah Chapman**, their work exemplifies how coordinated national networks operate as engines of systemic change rather than advocacy alone.

The importance of leadership pipelines was further reinforced through the work of **Dr Hossai Gul**, Founder of the Future STEMM Leaders programme at Macquarie University. Her work demonstrates how structured mentoring and professional networks enable early-career researchers from diverse backgrounds to build leadership capability, institutional influence, and confidence. Dr Gul's engagement with the Franklin Women network further illustrates how belonging to professional communities empowers individuals to initiate and sustain diversity-focused change within their own organisations.

Elaine Manton with Dr Hossai Gul

In engineering and industry, systemic barriers to retention emerged as a persistent constraint on innovation. Conversations with **Dr Collette Burke**, Victoria's first Chief Engineer, and **Madeleine McManus**, former Chair of Engineers Australia (Victoria), reinforced evidence that non-homogeneous teams deliver stronger outcomes. However, persistent structural challenges—including limited flexibility, pay inequity, and slow progression—continue to drive women out of engineering roles.

As Dr Burke's analysis demonstrates, innovation capacity is diminished when talent is lost due to structural barriers rather than capability or ambition.

"The causes of the lack of diversity in the engineering profession are complex. Fundamentally, we need to challenge cultural and social perceptions and stereotypes, and drive toward a long-term education strategy for parents, teachers and the community. We also need to keep investigating why, despite the many initiatives currently underway, we are not seeing the desired outcomes."

Dr Colette Burke

Colette Burke and Madeleine McManus

"If we don't have diverse people designing and building our technologies, we risk embedding bias into the systems that will shape our future."

Madeleine McManus

In the field of robotics and autonomous systems, diversity-driven innovation was particularly evident through the ecosystem-building work of **Andra Keay** in the United States. As Managing Director of Silicon Valley Robotics and founder of Women in Robotics, Keay operates at the intersection of innovation, ethics, and inclusion. Her work recognises that the future of autonomous and intelligent systems depends not only on technical excellence, but on diverse human perspectives shaping design, deployment, and governance.

Through initiatives such as Project Inspire, Project Connect, and Project Advance, Women in Robotics links visibility, mentoring, and leadership development directly to innovation outcomes. Complemented by platforms such as the Good Robot Awards and the Robot Launch global startup competition, Keay's work embeds diversity within entrepreneurial, ethical, and commercial pathways in emerging technologies. While not presented as a standalone case study, her contribution provides a powerful illustration of how inclusive ecosystems accelerate innovation in advanced technology sectors.

Across these examples, a consistent pattern emerges: innovation thrives when diversity is embedded through policy, leadership, networks, and accountability. Individuals do not operate in isolation; their impact is amplified when systems are designed to value difference, enable visibility, and support progression across career stages. Diversity, in this context, is not an adjunct to innovation, but a foundational condition for its sustainability and impact.

Elaine Manton with Andra Keay

> "How can women feel as if they belong in robotics if we can't see any pictures of women building or programming robots?"
>
> *Andra Keay*

Key Recommendations for the UK

1. **Embed Diversity within National and Institutional Innovation Frameworks**
   Strengthen structured equity frameworks, such as Athena SWAN, to ensure diversity is positioned as a driver of excellence, innovation, and workforce sustainability rather than a standalone equality initiative.
2. **Invest in Visible, Diverse STEM Leadership**
   Support national leadership roles and public-facing ambassadors that reflect gender, cultural, and identity diversity, recognising visibility as a powerful lever for participation, aspiration, and retention.
3. **Fund and Leverage Professional Networks as Innovation Enablers**
   Provide sustained support for STEM networks that integrate mentoring, leadership development, and policy influence, enabling diverse voices to shape institutional and national decision-making.
4. **Address Retention in Engineering and Emerging Technologies**
   Implement targeted policies to improve flexibility, progression, and workplace culture in engineering

and high-growth technology sectors, ensuring diverse talent is retained and able to contribute fully to innovation.

Theme 2: Curriculum Relevance, Integration, and Inquiry Bring STEM Learning to Life

Across my visits to schools, universities, industry partners, and education centres in both the United States and Australia, a consistent pattern emerged: effective STEM education is realised when curricula prioritise relevance, integration, and inquiry, supported by strong leadership, sustained professional development, and authentic real-world contexts. Where these elements were present, students demonstrated higher engagement, deeper understanding, and greater confidence in applying STEM knowledge beyond the classroom.

In the United States, this approach is strongly reflected in the **Next Generation Science Standards (NGSS)**, which provide a national framework designed to improve how students learn and apply scientific knowledge. By integrating disciplinary core ideas, crosscutting concepts, and science and engineering practices from kindergarten through high school, NGSS emphasises coherence, relevance, and application. During my Fellowship, I observed these principles in practice across a range of educational settings and states, reinforcing the importance of curriculum structures that foreground sense-making and problem-solving rather than content coverage alone.

Leadership emerged as a critical enabler of curriculum relevance. Time spent with **Scott McLeod** highlighted the role of school and system leaders in shaping learning environments that prioritise engagement, agency, and purposeful use of technology. His work reinforces the argument that technology adds value to STEM learning only when embedded within thoughtful curriculum design. This principle was most clearly realised where curriculum leadership was paired with deep industry–education collaboration.


Elaine Manton with Leif Brenne

Industry–education partnerships emerged as a particularly powerful mechanism for translating inquiry-based curriculum design into scalable classroom practice. A standout example of this was **Hacking STEM**, a Microsoft education initiative led by **Leif Brenne**, Principal Program Manager, and **Karon Weber**, Director of Hacking STEM. My engagement with the programme was enabled through direct collaboration with **James Burke**, whose leadership has been instrumental in the design, development, and classroom translation of Hacking STEM curriculum, and through whom I gained access to Microsoft's Hacking STEM labs during the Fellowship.

James Burke plays a central role in the design and delivery of Hacking STEM. As an educator and curriculum consultant, he co-writes the curriculum used across all Hacking STEM projects, working from first principles to design lessons that are accessible, data-driven, and grounded in authentic scientific and engineering practice. Rather than adapting existing materials, Burke and the Hacking STEM team develop lessons from scratch, then collaborate with classroom teachers to refine and scale these projects for wider use.

Burke's professional work spans the creation of accessible, data-rich STEM experiences in collaboration with organisations including **NASA**, **Microsoft**, and **Blue Origin**, with a consistent focus on increasing participation among women and girls in engineering and technology pathways. This work exemplifies how relevance, inquiry, and integration can be operationalised at scale when curriculum design is led by practising educators

with strong industry partnerships. His approach demonstrates how industry expertise can be translated into curriculum design that prioritises relevance, inquiry, and inclusion.

Alongside his consultancy work, Burke runs the engineering lab at **Tyee Middle School**, where he teaches STEM, Flight and Space, Design and Production, Robotics, and Applied Engineering. During my visit, I observed how project-based learning underpinned the curriculum, enabling students to engage with real-world problems through hands-on engineering challenges. Students were encouraged to collect, analyse, and interpret real data, developing both technical competence and confidence in applying STEM knowledge beyond the classroom.

"If students are collecting real data to solve real problems, they stop asking why they're learning STEM — they just get on with doing it."

James Burke

Through Hacking STEM, Burke also works in partnership with external organisations including The LEGO Group, Mattel's Hot Wheels, and the BBC, extending the reach and relevance of STEM learning across different contexts and audiences. These collaborations illustrate how curriculum co-design, when led by educators with deep classroom expertise, can bridge the gap between industry innovation and inclusive educational practice.

Importantly, my access to Microsoft's Hacking STEM labs and professional conversations with the wider team was enabled through Burke's leadership and networks. This reinforces a wider finding of the Fellowship: impactful STEM curriculum innovation is most effective when driven by educators who combine classroom credibility, industry partnership, and a clear commitment to widening participation.

Elaine Manton with James Burke

System-level expertise and research also play a vital role in shaping inclusive and effective STEM curricula. During a National Geographic evening reception, I had an unplanned but valuable opportunity to speak with **Dr Christopher Bowen**, District STEM Curricula Specialist for Johnson City Schools, Tennessee, and adjunct faculty member at East Tennessee State University. His research focuses on gender-equitable STEM curricula, female science identity, and the representation of marginalised groups within curricular materials. This conversation reinforced the importance of research-informed curriculum design, inclusive pedagogy, and specialist curriculum leadership in addressing unconscious bias and supporting broader participation in STEM education.

Elaine Manton with Dr Christopher Bowen

In Australia, similar principles were evident, though enabled through greater curricular flexibility. **Jenine Beekhuyzen** consistently advocates for STEM to be understood not as a collection of discrete subjects, but as a pedagogy that reflects how real-world problems are encountered and solved. Central to her work is the argument that sustained investment in teacher training and professional learning has a greater impact on student engagement and participation than expenditure on specialist equipment or facilities alone. At tertiary level, these curriculum principles were reflected in discussions at **Monash University** with **Professor Cristina Varsavsky**, Deputy Dean of Science. Monash's Bachelor of Science Advanced (Global Challenges) represents a deliberate rethinking of undergraduate science education. The programme integrates advanced disciplinary study with leadership, entrepreneurship, ethics, policy, and communication as core components, rather than optional additions. Through a selective cohort model, structured internships, and a year-long externally mentored project focused on real-world challenges, students are required to apply scientific knowledge within social, economic, and policy contexts. This approach positions graduates as scientifically capable and socially responsive problem-solvers, equipped with the agency and interdisciplinary understanding needed to address complex global challenges.

Elaine Manton with Professor Cristina Varsavsky

Elaine Manton with Penny Stoyles

Inquiry-based learning was further reinforced through my meeting with **Penny Stoyles** at the **Australian Academy of Technological Sciences and Engineering**, where I learned about Science and Technology Education Leveraging Relevance (**STELR)**. STELR is a national, curriculum-embedded programme designed to deliver hands-on, inquiry-based STEM learning in secondary schools. By focusing on real-world applications such as energy, sustainability, and engineering, and by providing comprehensive teacher support alongside purpose-built equipment, ensures equity of access and scalability. Its in-curriculum design avoids reliance on enrichment or extracurricular provision, enabling all students to engage meaningfully with STEM learning.

As a Loreto educator, I particularly valued visits to Loreto schools in Australia, where I observed how the STEM and Digital Technologies curriculum is interpreted to address gendered skills gaps. Across these schools, STEM was embedded across the curriculum rather than treated as a discrete subject area. Teachers demonstrated significant autonomy and innovation in curriculum design, drawing on approaches such as design thinking, entrepreneurial learning, and social justice focused challenges. The deliberate use of female role models, hands-on learning, and ethical inquiry was especially effective in building confidence, resilience, and engagement among girls.

Loreto Schools Australia — STEM and Digital Technologies in Practice

Elaine Manton with:

- Catherine Thawley, eLearning & Innovation Leader, and Dr Susan Stevens, Principal, *Loreto Toorak*, Melbourne
- Russ Morgan, eLearning and Technology Coordinator, *Loreto College Coorparoo*, Brisbane
- Dr Jonathon Mascorella, Director of Innovation, *Loreto Kirribilli*, Sydney

(Images illustrate whole-school approaches to embedding STEM and Digital Technologies within Loreto contexts.)

Curriculum delivery was further enriched through partnerships with specialist education centres. At the **Boyne Island Environmental Education Centre**, I observed how environmental and sustainability education provides a powerful context for STEM learning. Through fieldwork, ecological studies, and environmental monitoring, students engaged directly with scientific inquiry in authentic settings. The centre also supports teacher professional development and works closely with schools and community organisations, extending inclusive STEM opportunities to underrepresented groups, including girls.

Taken together, these experiences demonstrate that bringing STEM curricula to life requires more than content reform. It depends on relevance, integration, inquiry, and sustained support for educators. Where these conditions are present, STEM education becomes a vehicle for engagement, equity, and long-term participation along the pipeline.

Key Recommendations for the UK

1. **Real-World Relevance**
   STEM learning should be grounded in authentic, real-world contexts, using project-based and problem-based approaches to connect theory with practical application and societal challenges.

2. **An Integrated Approach**
   Interdisciplinary and cross-curricular projects should highlight the interconnected nature of STEM disciplines and their links to the arts, humanities, and social sciences.

3. **Inquiry-Based Learning**
   Students should be encouraged to ask questions, investigate open-ended problems, and develop critical thinking and problem-solving skills through inquiry-led approaches, supported by sustained professional development for educators.

Theme 3: Cultivating Future Innovators

3.1 Cultivating Future Innovators: Early Engagement and Identity Formation in STEM

In a rapidly evolving technological landscape, inspiring and nurturing the next generation of female innovators is both an educational and an economic imperative. Evidence from research and practice consistently demonstrates that **early engagement in STEM is critical to addressing persistent gender disparities** and to fostering inclusive, creative, and future-focused innovation. Interventions that begin in the early years play a formative role in shaping confidence, identity, and aspiration, laying the foundations for girls not only to participate in STEM, but to see themselves as future leaders within it.

Research indicates that gender bias emerges remarkably early. Research by Bian, Leslie and Cimpian[1] indicates that by the age of six children are already internalising stereotypes about brilliance and ability, with direct implications for girls' engagement, confidence, and self-concept in STEM. This underscores the importance of initiating positive STEM exposure and reinforcement well before secondary education, at a point when identity formation is particularly malleable.

This evidence is further reinforced by *Girls' Future – Our Future: The Invergowrie Foundation STEM Report*,[2] which identified several high-impact strategies for improving girls' participation in STEM. Key recommendations included starting interventions early and sustaining them over time, engaging girls with carefully selected and relatable role models, and providing ongoing, age-appropriate STEM career awareness. Crucially, the report emphasised that educators, families, industry, and government must work collaboratively to ensure that girls' choices are informed by opportunity rather than constrained by stereotypes about what girls can or should do.

A significant finding of the report was the misalignment between evidence and practice: while career guidance is typically concentrated in Years 10–12, research suggests that STEM career awareness should begin much earlier, potentially during primary education. Integrating STEM career awareness into the curriculum, rather than treating it as a late-stage or bolt-on activity, was identified as essential for sustained impact.

Targeted Initiatives Supporting Early Engagement

During the National Science Teaching Association (NSTA) Conference in St Louis (2019), I met representatives from **SciGirls**, an Emmy Award-winning PBS television series and outreach programme developed by Twin

[1] Bian, L., Leslie, S.-J., & Cimpian, A. (2017). *Gender stereotypes about intellectual ability emerge early and influence children's interests*. Science, 355(6323), 389–391.
[2] Hobbs, L., *et al.* (2017). *Girls' Future – Our Future: The Invergowrie Foundation STEM Report*. Melbourne: The Invergowrie Foundation.

Cities PBS in partnership with the National Girls Collaborative Project and the National Science Foundation. SciGirls is specifically designed to engage and empower girls aged 8–12, a critical period during which interest in STEM is known to decline.

The programme features diverse groups of girls undertaking collaborative STEM investigations with the support of female STEM professionals. Through both the television series and an extensive suite of educational resources—including lesson plans, hands-on activities, videos, and digital tools—SciGirls addresses stereotypes, builds confidence, and normalises girls' participation in STEM. Importantly, the programme places strong emphasis on family engagement, recognising parents and carers as key partners in sustaining girls' interest and aspiration. By ensuring representation of girls from diverse backgrounds, including Latina girls who face additional structural barriers, SciGirls demonstrates the power of inclusive media in shaping identity and aspiration.

The role of informal and experiential learning was further exemplified through **Zuckerberg Media**, founded by Randi Zuckerberg. One notable initiative, *Sue's Tech Kitchen*, blends food, science, and technology in an interactive, family-focused environment. Experiences such as 3D-printed pancakes, edible chemistry, and interactive robotics make STEM concepts tangible, playful, and accessible. By situating STEM learning within everyday contexts, the initiative reinforces the message that STEM is for everyone, not just those who fit traditional stereotypes.

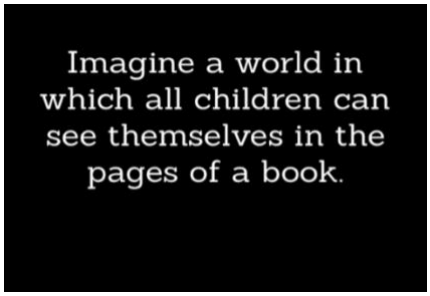
Elaine Manton with Jim Augustine – COO Zuckerberg Media

Representation Through STEM and STEAM Literature

Alongside media and experiential learning, representation within STEM and STEAM literature plays a vital role in early engagement. Ensuring that children—particularly girls—see themselves reflected in both fiction and non-fiction STEM texts is crucial in shaping identity, confidence, and aspiration. Inclusive literature challenges male-dominated narratives, provides visible role models, and reinforces the message that success in STEM is attainable. During the middle years (typically ages 8–13, corresponding to upper primary and early secondary education), when girls' interest often declines, representation becomes a powerful lever for sustaining engagement and encouraging diverse ways of thinking about science and technology.

Elaine Manton with author Jessica Fries-Gaither

Key Recommendations for the UK: Early Engagement and Identity Formation



The UK should prioritise early, sustained STEM engagement for girls beginning in primary education, rather than concentrating interventions predominantly at GCSE and post-16 stages. Evidence from international practice highlights the importance of embedding STEM curiosity, confidence, and career awareness well before stereotypical perceptions of ability become entrenched.

Specifically, UK education systems should:

1. **Integrate STEM career awareness and representation** within the primary and lower secondary curriculum, rather than treating careers education as a late-stage or bolt-on activity.
2. **Invest in inclusive media, literature, and informal learning partnerships** that reflect diverse female STEM identities and normalise girls' participation.
3. **Support family-engaged STEM initiatives** that recognise parents and carers as critical influencers of aspiration, particularly during the ages where interest commonly declines.

3.2 Cultivating Future Innovators: Sustaining Engagement Through Authentic Research

While early engagement is essential, sustaining girls' participation in STEM beyond school requires learning environments that build confidence, identity, and a sense of belonging over time. My visit to **Kean University**, located approximately 30 minutes from New York City, provided a compelling example of how universities can retain and empower diverse STEM students through early access to authentic research experiences and an inclusive institutional culture.

Kean University demonstrates a strong commitment to applied learning, equity, and STEM engagement. Initiatives such as the Kean STEM Scholars Program support high-achieving students through scholarships, research opportunities, and targeted professional development. Investment in state-of-the-art laboratories and research centres ensures that students gain hands-on experience aligned with contemporary scientific practice.

Kean's interdisciplinary approach encourages collaboration across STEM disciplines and with areas such as business, the arts, and social sciences, reflecting the complexity of real-world problem-solving. This is reinforced through extensive partnerships with industry, government, and academic institutions, providing internships, cooperative education, and applied research emphasis on diversity, inclusion, and community engagement, offering mentorship, networking, and outreach programmes to support underrepresented groups in STEM and to promote aspiration among K–12 learners.

I was particularly impressed by Kean's **Research First Initiative (RFI)**, embedded within the New Jersey Center for Science, Technology, and Mathematics (NJCSTM). RFI engages students in authentic scientific research from their first year of university under the mentorship of faculty scientists. Rather than encountering research only in later stages of a degree, students immediately experience the practices, uncertainty, and excitement of scientific discovery.

This approach builds scientific identity and confidence while developing critical skills such as quantitative literacy, translational science, problem-solving, and scientific communication. Students gain recognition that enhances their academic and professional profiles, alongside opportunities to present at symposia and publish in academic journals.

The initiative was spearheaded by Dr Keith Bostian, Dean of NJCSTM. Among the staff I met was Dr Dil Ramanathan, Assistant Professor, who plays a key role in both RFI and the Group Summer Scholars Research Program. Dr Ramanathan is a recognised advocate for women in STEM, providing sustained mentorship and support to female students. Her impact is reflected in multiple accolades, including the Faculty Research Mentor of the Year Award and recognition by the New Jersey General Assembly. '"As the most senior female faculty member in the STEM program at Kean, Dr. Ramanathan is continuously paving a path for future generations of scientists, especially underrepresented female students. Her passion for chemistry and education are the cornerstones of her success and her innate desire to help those who might otherwise be overlooked give her all the motivation she needs to keep overcoming obstacles while breaking barriers in the process. She is an extraordinary role model for young women pursuing a career in STEM."*Dr Keith Bostian, Dean of NCSTM.*

Kean University illustrates how early access to authentic research can transform undergraduate STEM education from content acquisition to identity formation, supporting persistence, progression, and leadership among women and underrepresented groups.

Elaine Manton with students from Kean's Research First Initiative (RFI)

Key Recommendations for the UK: Sustaining Engagement Through Authentic Research

To improve retention and progression within STEM degree pathways, UK universities should:

1. **Embed structured undergraduate research experiences from the first year of STEM degrees.**
2. **Recognise and reward staff who provide sustained mentorship for women in STEM, particularly in research-intensive disciplines.**
3. **Strengthen partnerships between universities, schools, and industry to create visible, coherent STEM pathways.**

3.3 Cultivating Future Innovators: Translating STEM Expertise into Innovation and Leadership

While early engagement and research-rich learning environments are critical, a persistent leak in the STEM pipeline occurs at the point where knowledge and capability must translate into innovation, enterprise, and leadership. It is at this transition—between education and sustained economic participation—that many women exit STEM pathways.

My engagement with **Danielle Neale**, then Entrepreneur in Residence within the Faculty of Engineering at the University of New South Wales, provides a compelling example of how targeted institutional roles can address this gap. In this role, Neale embedded entrepreneurial thinking, industry collaboration, and real-world problem-solving directly within the engineering faculty, ensuring that innovation was positioned as an integral component of STEM education rather than an optional add-on.

Through initiatives such as UNSW TechConnect, Innovation Central Sydney, The Maker Games, and Engineering Impact, Neale created structured opportunities for students, researchers, and doctoral candidates to engage with industry partners, develop ventures, and build confidence in translating technical expertise into societal and economic impact. Importantly, these initiatives normalised entrepreneurship and leadership within STEM environments, offering visible pathways beyond traditional academic or technical roles—pathways in which women are frequently underrepresented.

Elaine Manton with Danielle Neale

The Entrepreneur-in-Residence model directly addresses a well-documented weakness in the STEM pipeline: the absence of sustained support at the point where learners must see themselves not only as capable scientists or engineers, but as innovators, leaders, and change-makers. By positioning entrepreneurial capability as learnable, supported, and socially valuable, this model reframes success in STEM and helps retain diverse talent within the innovation ecosystem.

Key Recommendations for the UK: Translating STEM Expertise into Innovation and Leadership

To strengthen progression from STEM education into innovation and leadership, the UK should:

1. **Pilot Entrepreneur-in-Residence (EiR) models in secondary schools and sixth forms,** particularly those with strong STEM or technical pathways.
2. **Target girls at key transition points (Key Stage 3, GCSE selection, post-16),** reframing STEM as a pathway to agency, leadership, and societal impact.
3. **Align EiR models with existing UK structures,** including STEM hubs, University Technical Colleges (UTCs), and Careers Hubs, to ensure scalability and sustainability.
4. **Build educator capability alongside student impact,** ensuring EiRs leave a lasting legacy beyond the residency period.

Closing synthesis

Taken together, these findings demonstrate that effective STEM equity strategies must operate across the full educational pipeline. Early engagement ignites curiosity and identity; authentic research consolidates confidence and belonging; and innovation-in-residence models translate capability into leadership and impact. Isolated interventions are insufficient—lasting change requires coherent, system-wide approaches that support girls and women from first exposure through to professional participation in STEM.

Theme 4: Strengthening STEM Pathways through High-Quality Vocational Education and Training

Although not the central focus of the Fellowship, targeted examination of high-performing vocational education and training (VET) models provided valuable insights into how applied, industry-aligned pathways can strengthen participation, progression, and workforce readiness within STEM-related fields. International

evidence demonstrates that when vocational pathways are well-designed, well-resourced, and closely aligned with industry, they play a critical role in addressing skills shortages and broadening access to STEM careers.

Industry-Aligned Vocational Pathways in Practice

My visit to Holmesglen TAFE in Melbourne—part of Australia's Technical and Further Education (**TAFE**) sector, a network of government-funded vocational education providers delivering practical, industry-aligned training—provided a compelling example of how sustained industry collaboration enhances the quality, relevance, and status of vocational education and training (VET), particularly within STEM-related pathways. As one of the largest TAFE providers in Victoria, Holmesglen has developed a strong reputation for excellence through applied learning, industry-aligned curriculum design, and research-informed vocational education. During my visit, I met with **Dr Henry Pook** – Director – Centre for Applied Research and Innovation, senior leaders, programme managers, and teaching staff across the Chadstone and Moorabbin campuses, gaining insight into curriculum design, industry engagement, and workforce-aligned delivery within STEM-related fields.

Holmesglen operates across multiple campuses; my visit focused on Chadstone—the largest campus—and Moorabbin, which specialises in health, hospitality, and trades training. At Chadstone, I observed how industry-standard facilities, including advanced workshops, simulation environments, and technology-rich learning spaces, support students to develop practical skills aligned with current workforce expectations. Curriculum design is underpinned by close engagement with industry partners, who contribute directly to competency standards, programme content, and the provision of modern equipment and facilities.

Industry collaboration at Holmesglen extends beyond curriculum relevance to include structured work-based learning through apprenticeships, traineeships, and industry placements. These partnerships ensure that students graduate with both technical competence and real-world experience, improving employability and supporting smooth transitions into the workforce. Guest lectures, industry-led workshops, and ongoing feedback mechanisms further ensure that curricula remain responsive to emerging technologies and evolving skills needs.

At the Moorabbin campus, I met **Margaret Kerr**, who has played a significant role in reviewing STEM initiatives at Holmesglen and in developing collaborative partnerships between education and healthcare providers. Of particular note is the integration of the Bachelor of Nursing programme within **Holmesglen Private Hospital**, located on the Moorabbin campus. As the first TAFE in Australia to deliver a Bachelor of Nursing in a hospital setting, Holmesglen has created an immersive educational model that directly links theoretical learning with clinical practice.

Elaine Manton with Dr Henry Pook

Elaine Manton with Margaret Kerr

This approach supports students to develop professional confidence, practical competence, and a strong understanding of workplace expectations, while simultaneously benefiting healthcare providers through workforce development aligned to local and regional needs. The model illustrates how vocational and applied higher education pathways can be elevated through deep integration with industry and professional contexts.

Across both campuses, Holmesglen demonstrates how vocational education can be positioned as innovative, rigorous, and central to addressing workforce demand in key STEM-related sectors. The model challenges traditional perceptions of VET as a secondary or lower-status option, instead presenting it as a high-quality, aspirational pathway grounded in applied expertise, progression opportunities, and strong industry alignment.

Key Recommendations for the UK: Strengthening Vocational STEM Pathways

In the UK, initiatives such as **T Levels** and **University Technical Colleges (UTCs)** represent significant policy efforts to strengthen vocational pathways. While these programmes have increased employer engagement and provided clearer technical routes for some learners, international evidence suggests that further system-level alignment is required—particularly in relation to awareness, accessibility, gender participation, and consistency of industry partnership across regions.

Drawing on insights from Holmesglen TAFE, three key recommendations emerge for enhancing vocational STEM education in the UK:

1. **Targeted Outreach and Reframing of VET Pathways**
   Vocational STEM pathways should be actively promoted through coordinated outreach involving schools, industry partners, and further education providers. Messaging should emphasise progression routes, real-world impact, and long-term career opportunities in order to improve perceptions among students, parents, and educators.

2. **Stronger Alignment with Industry Needs**
   UK VET providers should deepen partnerships with industry through advisory boards, co-designed curricula, and embedded work-based learning. This would ensure that programmes remain responsive to evolving technologies, workforce demands, and regional economic priorities.

3. **Sustainable Funding and Incentives**
   Increased investment is required to support high-quality vocational STEM education. This includes targeted funding, scholarships, and public–private partnerships to improve access, facilities, and long-term sustainability of VET provision.

By strengthening industry collaboration and elevating vocational pathways—drawing on international models such as Holmesglen TAFE—the UK can enhance workforce readiness, address STEM skills shortages, and ensure vocational education is recognised as a credible, high-status, and aspirational route into STEM careers.

Conclusion

This Fellowship set out to explore how girls' participation and progression in STE(A)M education and careers might be strengthened through innovation, problem-solving, and system-level change. Through visits to schools, universities, industry partners, research institutions, and community organisations across Australia and the United States, the Fellowship examined how different education systems and ecosystems respond to the persistent gender imbalance in STEM. Rather than adopting a purely academic or comparative policy lens, the Fellowship prioritised observation, professional dialogue, and lived practice, seeking to identify approaches that could meaningfully inform and strengthen provision within the UK context.

Across highly diverse settings, a consistent finding emerged: meaningful and sustained engagement of girls in STE(A)M does not result from isolated interventions or short-term programmes. Instead, it is the product of interconnected systems that align curriculum, culture, leadership, industry engagement, and professional networks. Where progress was strongest, responsibility for equity did not sit with individual students or teachers, but was embedded within institutional structures, partnerships, and long-term strategies.

A central insight of the Fellowship is that STEM identity must be developed early and supported continuously. Evidence from schools, outreach programmes, and higher education settings demonstrated that girls' confidence, curiosity, and sense of belonging in STEM are shaped well before formal subject choices are made. Systems that invest in early engagement, visible role models, and sustained reinforcement—particularly at key transition points—are more successful in retaining girls through secondary education, post-16 pathways, and into higher education and employment. This finding highlights the limitations of late-stage interventions and reinforces the need for identity-led, rather than purely attainment-led, approaches to STEM education.

Mentorship and professional networks also emerged as critical system enablers. Across case studies, mentoring was most effective when it was structured, long-term, and embedded within broader ecosystems spanning education, industry, and community. Programmes that connected girls and women to visible role models, professional sponsors, and peer networks supported not only individual progression, but also cultural change. Importantly, successful models extended beyond recruitment to address retention, leadership, and workplace culture—demonstrating that fixing the system, rather than fixing the individual, is essential for lasting change.

The Fellowship further reinforced the importance of curriculum design in shaping participation and aspiration. In both Australia and the United States, the most effective STEM curricula were characterised by relevance, integration, and inquiry. Project-based learning, real-world problem-solving, and interdisciplinary approaches enabled students to experience STEM as purposeful, creative, and socially meaningful. When combined with strong professional development and educator autonomy, these approaches supported inclusive participation and deeper engagement. These findings suggest that curriculum reform must prioritise how STEM is experienced, not only what content is delivered.

Industry engagement was most impactful where it was embedded rather than peripheral. Strong vocational and academic pathways were underpinned by sustained partnerships with employers, research institutions, and innovation organisations. Models incorporating industry-aligned curricula, authentic work-based learning, and innovation-in-residence approaches demonstrated how STEM education can respond to workforce needs while remaining inclusive and aspirational. In particular, high-quality vocational education models that combined applied learning with clear progression routes challenged traditional hierarchies between academic and technical pathways and offered credible alternatives for diverse learners.

Leadership and policy coherence emerged as defining features of successful systems. Across higher education, industry, and professional organisations, progress towards gender equity was strongest where senior leadership explicitly owned responsibility for inclusion and where equity was embedded within governance, funding, and strategic priorities. Where gender equity was treated as central to innovation and workforce sustainability—rather than as a standalone equality issue—impact was deeper and more sustainable.

Taken together, the findings of this Fellowship indicate that increasing girls' participation and progression in STE(A)M requires a shift from fragmented initiatives to coordinated, system-level action. For the UK, this means investing in early and sustained STEM identity formation; embedding mentorship and networks across the education-to-employment lifecycle; designing curricula that are relevant, integrated, and inquiry-led; strengthening authentic industry partnerships; and ensuring leadership and policy frameworks explicitly prioritise gender equity.

There is no single solution to addressing the leaky STEM pipeline. However, international practice demonstrates that when systems are intentionally designed to support inclusion, agency, and progression, girls and women do not simply participate in STEM—they lead, innovate, and shape its future. By adapting these insights thoughtfully within the UK context, there is a significant opportunity to strengthen STEM education, enhance workforce diversity, and ensure that innovation is driven by the full range of talent available.

Appendix A: Summary of UK Recommendations

This appendix consolidates the UK-focused **recommendations** arising from the case studies and thematic analysis presented in this report. Recommendations are grouped first by Case Studies, followed by Thematic Recommendations, to provide clarity and ease of reference for policymakers, educators, and practitioners.

Case Study Recommendations

1. Changing the Status Quo – Dr Marguerite Evans-Galea AM

Key Recommendations for the UK

- Establish industry–academia mentorship programmes modelled on initiatives such as IMNIS, connecting students with industry leaders to provide career guidance, skills development, and insight into diverse STEM pathways.
- Strengthen support for gender equity organisations in STEMM, enabling advocacy, networking, and visibility for women through sustained funding and strategic partnerships.
- Increase public engagement and visibility of STEMM professionals through national events, symposia, and media activity to raise aspirations and foster collaboration.

2. Deeper Learning – Dr Scott McLeod (Denver, Colorado)

Key Recommendations for the UK

- Invest in flexible, industry-aligned STEM learning environments that integrate engineering, technology, and collaborative learning aligned with curriculum goals and real-world applications.
- Embed project-based and design-led STEM learning across all school phases, strengthening problem-solving, creativity, and applied STEM skills from primary through secondary education.
- Strengthen sustained partnerships between schools, industry, and higher education to provide mentoring, competitions, internships, and authentic STEM projects.

3. 1000 Girls, 1000 Futures – New York Academy of Sciences

Key Recommendations for the UK

- Expand mentorship programmes for young women in STEM, pairing students with female STEM professionals to build confidence, provide role models, and enhance career insight.
- Enhance access to STEM resources and opportunities, particularly for underserved communities, through investment in online platforms, workshops, and hands-on learning.
- Promote diversity and inclusion initiatives in STEM, including targeted scholarships and programmes designed to widen participation and progression.

4. Gender Diversity in STEM – Professor Elizabeth Croft

Key Recommendations for the UK

- Embed gender equity within senior academic leadership, with explicit responsibility for inclusion incorporated into governance, policy, and strategic decision-making.
- Develop sustained mentorship and industry-engaged networks supporting progression, retention, and visibility for women in STEM.
- Align research, policy, and inclusive educational practice, ensuring curriculum design and institutional initiatives are informed by evidence and equity goals.

5. Innovation – Great Minds Don't Think Alike: Building STEM Ecosystems Through Collaboration. A case study of Dr Jenine Beekhuyzen, with linked practice from Dr Linda Pfeiffer

Key Recommendations for the UK

- Introduce early, purpose-driven STEM engagement that emphasises technology for social good and community connection.
- Strengthen access to visible role models and mentors, particularly at key educational transition points.
- Develop relevant and relatable STEM content that connects learning to real-world issues meaningful to girls and their communities.
- Create supportive ecosystems across school, home, and community, involving educators, families, industry, and local partners.

6. Girls for a Change – Tara Chklovski

Key Recommendations for the UK

- Adopt project-based, real-world STEM learning models enabling girls to address authentic community challenges through technology.
- Scale mentorship-led, community-embedded programmes that combine local adaptability with national coordination.
- Promote equity, ethical technology use, and global perspectives within STEM curricula and initiatives.

7. Fix the System, Not the Girls – Girl Geek Academy – Sarah Moran

Key Recommendations for the UK

- Invest in inclusive workplace reform, addressing culture, progression pathways, and retention across STEM industries, rather than focusing solely on recruitment.
- Provide sustained investment in proven models, moving beyond short-term pilots to scale initiatives with demonstrated impact.
- Support ecosystem-based approaches that operate across education, industry, and policy to enable system-level change.

8. Mother Nature Needs Her Daughters – Fabian Dattner

Key Recommendations for the UK

- Establish and sustain women in STEMM networks across education, research, and industry, with long-term funding and structural support.
- Invest in leadership development with a focus on visibility, addressing confidence, communication, strategic influence, and progression.

9. Creating Robots That See – Dr Sue Keay

Key Recommendations for the UK

- Implement integrated mentorship and networking frameworks supporting women across education, early career, leadership, and entrepreneurship.
- Embed gender equity within STEM policy and leadership, including flexible working, parental leave, and bias-aware recruitment and promotion practices.
- Strengthen early engagement and visible role models, particularly in emerging fields such as AI and robotics.

Thematic Recommendations

Theme 1: Diversity Drives Innovation

Key Recommendations for the UK

- Embed diversity within national and institutional innovation frameworks, positioning equity as a driver of excellence and workforce sustainability.
- Invest in visible, diverse STEM leadership, including national ambassadors and public-facing roles.
- Fund and leverage professional networks as innovation enablers, integrating mentorship, leadership development, and policy influence.
- Address retention in engineering and emerging technologies through targeted policies on flexibility, progression, and workplace culture.

Theme 2: Curriculum Relevance, Integration, and Inquiry Bring STEM Learning to Life

Key Recommendations for the UK

- Ground STEM learning in real-world relevance through project-based approaches addressing societal challenges.
- Adopt integrated, interdisciplinary learning models highlighting connections between STEM, the arts, humanities, and social sciences.
- Promote inquiry-based learning that develops critical thinking, problem-solving, and curiosity.

Theme 3: Cultivating Future Innovators

Early Engagement and Identity Formation in STEM

Key Recommendations for the UK

- Prioritise early, sustained STEM engagement for girls, beginning in primary education.
- Integrate STEM career awareness and representation within primary and lower secondary curricula.
- Invest in inclusive media, literature, and informal learning partnerships that normalise diverse female STEM identities.
- Support family-engaged STEM initiatives, recognising parents and carers as key influencers of aspiration.

Theme 4: Enhancing Vocational Education through Industry Collaboration

Key Recommendations for the UK

- Reframe vocational STEM pathways through targeted outreach, emphasising progression routes, impact, and career opportunities.
- Strengthen alignment with industry needs through advisory boards, co-designed curricula, and embedded work-based learning.
- Provide sustainable funding and incentives to support high-quality vocational STEM education, access, and long-term viability.

Appendix B: Fellowship Itinerary and Meetings

Australia	6th August to 20th August 2018
Melbourne 13th to 18th August	
Australian Academy of Technology and Engineering (ATSE)	Dr Marguerite Evans-Gallea AM – (ATSE) Executive Director Penny Stoyles – STELR Programme Manager (ATSE)
Holmesglen Institute	Dr Henry Pook – Director – Centre for Applied Research and Innovation
Holmesglen Private Hospital	Margaret Kerr – Head of School (Nursing)
Homeward Bound	Fabienne Dattner – Founder of Dattner Group and Homeward Bound Projects
Loreto Mandeville Hall School Toorak	Dr Susan Stephens; Catherine Thawley – eLearning & Innovation Leader at Loreto Toorak
Monash University	Madeleine McManus – Director Industry Engagement Office of the President and Vice Chancellor Professor Cristina Varsavsky – Deputy Dean Faculty of Science Professor Elizabeth Croft – Dean of Engineering
Chief Engineer of Victoria	Collette Burke
Girl Geek Academy	Sarah Moran – CEO and Co-Founder Girl Geek Academy
Brisbane 19th to 25th August	
CQ University	Dr Linda Pfeiffer – Associate Professor, Australia Pacific LNG STEM Central Project Lead
Tech Girls Movement	Jenine Beekhuyzen – CEO of Tech Girls Movement

Queensland STEM Education Network	Kay Lembo – Manager, Queensland STEM Education Network; Chair, International Advisory Board NSTA
Loreto Coorparoo	Russ Morgan – eLearning and Technology Coordinator Lissa Gyte – Acting Director of Professional Learning and Cognitive Education
Sydney 26th to 31st August	
UNSW	Danielle Neale – Entrepreneur-in-Residence, Engineering
Loreto Normanhurst	Ms Kieryn Bateman – Director of Learning
Loreto Kirribilli	Dr Jonathon Mascorella – Director of Innovation
USA	**10th April to 6th May**
St Louis 10th to 14th April	Attendance at the 75th National Science Teaching Association (NSTA) National Conference on Science Education in St Louis took place during the Fellowship period and was supported through additional funding approved by the Churchill Fellowship.
New Jersey/New York 14th to 17th April	
Kean University, New Jersey USA	Keith A. Bostian, PhD – Dean, NJ Center for Science Technology and Mathematics (NJCTM) Dr Dil Ramanathan – Assistant/Associate Professor (NJCSTM)
New York Academy of Science	Kaari Casey – Senior Program Manager, Virtual Programs & Products
Zuckerberg Media	Jim Augustine – COO Zuckerberg Media
Boston 17th to 20th April	
Autodesk BUILD Space	Yuri Cataldo – Innovation Education Manager, The Autodesk BUILD Space
Center for Bits and Atoms – Massachusetts Institute of Technology MIT	Sherry Lassiter – President and CEO, The Fab Foundation, Fab Labs, MIT (met virtually as Sherry was travelling)

	James Prue – Assistant to Dr Neil Gershenfeld in the Center for Bits and Atoms
Denver, Colorado 20th to 24th April University of Colorado	 Dr Scott McLeod – Associate Professor of Educational Leadership at the University of Colorado, Denver Two days of site visits across six schools, focusing on leadership, curriculum design, and system-level innovation.
San Francisco 24th to 30th April Technovation Silicon Valley Robotics	 Tara Chklovski – Founder, CEO, Iridescent/Technovation Andra Keay – Managing Director, Silicon Valley Robotics
Seattle, 30th April to 6th May Microsoft Tyee Middle School	 Leif Brenne – Senior Program Manager at Microsoft, Hacking STEM team James Burke – STEM/CTE Teacher Tyee Middle School, Curriculum Consultant for Microsoft 'Hacking STEM'