



An Roinn Oideachais
Department of Education

Recommendations on Gender Balance in STEM Education

8th March 2022

Context

The recommendations as set out in this document were informed by the Gender Balance in STEM Advisory Group, a group set up by the Department of Education's STEM Education Implementation Advisory Group (IAG) in order to guide national actions that will ensure STEM education in Ireland is world class in improving gender balance, equity and inclusion effectively for our young people.

STEM Education Policy Statement

The Department of Education published the national STEM Education Policy Statement 2017-2026 (Policy Statement) and STEM Education Implementation Plan 2017-2019¹ in November 2017. This comprehensive policy statement was informed by extensive research and consultation. At its heart is the vision:

In line with our ambition to have the best education and training service in Europe by 2026, Ireland will be internationally recognised as providing the highest quality STEM education experience for learners that nurtures curiosity, inquiry, problem-solving, creativity, ethical behaviour, confidence and persistence, along with the excitement of collaborative innovation.

The Policy Statement acknowledges that there is a need to increase broader participation in STEM Education and to enhance STEM learning for learners of all backgrounds, abilities and gender, with a particular focus on increasing participation in STEM by females. It identifies the importance of addressing any risks of disadvantage and underrepresentation in the implementation of the policy.

The Policy Statement recognises that STEM education is multi-faceted and goes well beyond the main disciplines that constitute the acronym – Science, Technology, Engineering and Mathematics. Within these four STEM disciplines there are a wide range of STEM areas and subjects that learners can engage in during their school life. These can range from designing and making in early years and primary school to Science, Technology, Engineering and Mathematics at all levels.

The policy sets out ambitions for the full STEM ecosystem (figure 2), including outcomes for learners, teachers and early learning educators, for schools and early years settings, and for society.

¹ <https://www.gov.ie/en/policy-information/4d40d5-stem-education-policy/>

The policy recognises the need to improve gender balance in STEM education. To support the development and delivery of relevant gender balance actions within the policy, a Gender Balance in STEM Education Advisory Group was established.

STEM Education

In Ireland, out of almost 120,000 people working in STEM, just a quarter are women. However, this phenomenon is not unique to Ireland. For example, in Europe less than 7 per cent of technology jobs are filled by women, with the number of female entrants to computer science in the US still declining. The STEM areas have traditionally attracted and retained more males than females. To make a STEM career appealing, all learners, and especially females, need to be made aware of the exciting opportunities available and be able to see people like them working in these areas.

STEM education is a shared responsibility across government departments and agencies, education stakeholders, schools, teachers, families, business/industry and communities. This report shows the need to bring together these key constituencies to build a coordinated approach to addressing gender balance in STEM education.

The continuum of STEM Education and key STEM skills from early years to post-primary are identified within the Policy Statement and set out in figure 1 below.

Early Childhood themes, Primary priorities, Junior and Senior Cycle Key Skills							
Level 4	Senior Cycle key skills	Critical and creative thinking		Communicating	Information processing		Being personally effective
Level 3	Junior Cycle key skills	Managing information and thinking	Being Literate Being numerate	Communicating	Staying well	Being creative	Managing myself
Level 2	Primary priorities	Develop thinking, learning and life skills		Communicating well	Be well		Engage in learning
Level 1	Early childhood themes	Exploring and thinking		Communicating	Well-being		Identity and belonging

Figure 1 – Key STEM Skills from early years to post-primary

The foundations for STEM education begin in early childhood. From the earliest years through their play experiences and family environment, children engage with the world in ways that can promote learning related to Science, Technology, Engineering and Mathematics. Young children naturally engage in early STEM exploration through hands-on multisensory and creative experiences. By engaging in these experiences, young children

are developing curiosity, inquisitiveness, critical-thinking and problem-solving capacities which are built on through their primary and post-primary school experience.

Literature Review – ‘To Identify a set of Effective Interventions for Addressing Gender Balance in STEM in Early Years, Primary and Post-Primary Education Settings’

It was agreed by the Advisory Group that while there were many interventions underway in Ireland, little was understood on what was effecting change. As its first action, the Advisory Group commissioned a literature review ‘A Review of Literature to Identify a Set of Effective Interventions for Addressing Gender Balance in STEM in Early Years, Primary and Post-Primary Education Settings’.

Following a tender process, carried out in October 2019, by the Department of Education a contract was awarded to the University of Limerick with a team led by Professor Merrilyn Goos.

The literature review was undertaken to ensure any recommendations made by the group were founded in, and informed by, the available data and evidence. The review was broken into two parts, Stage I which was to identify a set of critical barriers to girls’ STEM participation and Stage II which was to identify effective interventions to address prioritised barriers and associated measures of success. Following initial discussions between the Advisory Group and the team from University of Limerick it was agreed to broaden the scope of the review to include early years.

THE LITERATURE REVIEW

The Literature Review report is a strong, comprehensive review of the key challenges and barriers to gender balance in STEM. It identifies the transition points from early years to primary, primary to post-primary and junior cycle to senior cycle, as key areas of consideration for interventions in STEM. The review identifies ecological factors at individual, family, institutional and societal levels which are influencing girls’ and women’s participation, achievement, and progression in STEM studies.

The literature review analyses the challenges and barriers to gender balance in STEM. It points to the fact that there is no single intervention that will achieve gender equity, rather there is a requirement to support multiple interventions addressing different segments of the ecosystem (Figure 2) to effect the change required.

² <https://www.gov.ie/en/policy-information/4d40d5-stem-education-policy/#gender-balance-in-stem>

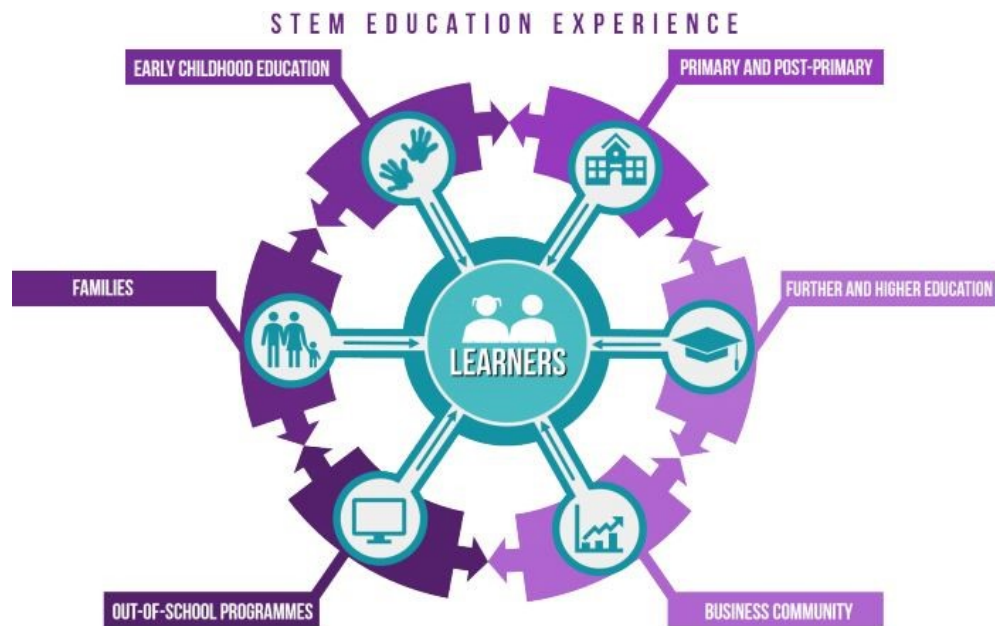


Figure 2 – STEM EcoSystem, STEM Education Policy Statement 2017-2026

It also points to ensuring actions are taken from early years through to post-primary, avoiding short-term interventions that lack connections to broader purpose, instead ensuring joined-up partnerships where families, early years settings, schools, policy, industry and society all play a connected part in providing access. There is a need to move away from seeking a change in girls' attitudes, beliefs and behaviours, but rather seek to change structures, policies and broader representation of STEM in society, to ultimately break down the barriers to more balanced participation. The recommendations presented by the Advisory Group take consideration of all this and are presented as actions to impact on each part of the ecosystem. Important structural changes are dealt with first in each section.

Phase 1 Recommendations

These recommendations are made to address equity of access and inclusion, rather than just gender balance. By addressing the wider diversity issue in STEM, gender balance in STEM will benefit.

It is acknowledged that there is a need to build knowledge, attitudes and skills in the STEM disciplines across early years and school communities to include leaders, early years educators, teachers, parents/guardians and learners. We must build on this through conducting research, ensuring the preparation of teachers who are STEM literate, the provision of experiential and inquiry-based teaching and learning and the use of innovative teaching and learning modalities to include technology-enhanced learning.

It is noted that specifics of all of these recommendations will be considered for inclusion in phase two STEM Education Implementation Plan 2022-2026. Their inclusion will also be assessed against available resources within the Department of Education. Allocation of responsibility and timelines for implementation will be detailed in the implementation plan.

Key areas for action

The **four key areas for action**, as set out by the Gender Balance in STEM Advisory Group, build on, and are additional to, the extensive actions identified in the STEM Education Implementation Plan 2017-2019 are:

1. Improve equity of participation across all STEM curriculum areas/subject choices by instilling whole school culture change, to include early years leaders and educators, school leaders, teachers learners and parents/guardians
2. Provide effective support in relation to practice in STEM for early years educators and teachers
3. Support equitable learner access to, and experiences of, STEM to inspire learning, foster creativity and prepare for later engagement and success
4. Support a societal and cultural shift to address current barriers to gender balance in STEM.

These areas will be actioned by implementation of the recommendations set out below.

Recommendations

IMPROVE EQUITY OF PARTICIPATION ACROSS ALL STEM CURRICULUM AREAS/SUBJECT CHOICES BY INSTILLING WHOLE SCHOOL CULTURE CHANGE TO INCLUDE EARLY YEARS/SCHOOL LEADERS, EDUCATORS/TEACHERS AND PARENTS/GUARDIANS

How STEM is taught in our early years settings and schools has an impact on the participation of young females in STEM. Factors such as the use of gender inclusive

language, visual prompts and examples in curricula and lesson planning can influence how our female learners perceive and relate to STEM. There is a need to build confidence at a whole school level so as to maximise engagement and exploration in STEM, both through formal and informal learning.

Specific actions to deliver:

1. Continued consideration of gender balance, equity and inclusion in the development and/or review of national curriculum specifications. This will include all Department of Education policies, strategies and resources.
2. Assessment practices that are aligned broader STEM goals (as outlined in the Policy Statement) and support for student-centered inquiry-based learning should be integral to the development of STEM education.
3. Explore the development, setup in schools and ongoing monitoring of a national accreditation framework for whole school culture change at primary and post-primary levels, to address gender balance, equity and inclusion actions.
4. Development of the SFI Discover Primary Science and Maths programme, to include consideration of gender equality and inclusion in the language, visuals and examples used throughout the programme and in professional development offered to teachers.
5. A study in relation to timetabling and availability of subjects at post-primary level should be undertaken to understand where, how and why barriers are present that prevent access to students to specific subjects. This study will inform the development of guidelines for schools in relation to successful strategies for schools to adopt to improve uptake and the provision of a wider range of STEM subjects.

PROVIDE EFFECTIVE SUPPORT IN RELATION TO PRACTICE IN STEM FOR EARLY YEARS EDUCATORS AND TEACHERS

Early years educators and teachers use their expertise and experience, as well as evidence, to make informed decisions about their practice so as to help learners achieve particular goals. It is vital that educators and teachers are supported in the development of these teaching practices.

It is important to highlight in the early stages of teacher education and with in-service teachers the influential role educators/teachers hold and to raise awareness of the many actions they can lead on, or contribute to, to drive change in their settings.

It is also important to provide the necessary supports to ensure increased numbers of qualified STEM teachers whilst also seeking to increase the diversity of STEM teachers in our schools.

Specific actions to deliver:

6. The Teaching Council should be invited to be a member of the STEM Education Implementation Advisory Group to ensure alignment of goals, realistic outcome setting and implementation of policy.

7. All programmes of teacher education and post graduate guidance counselling programmes across the continuum should include awareness raising training on the barriers to participation of underrepresented groups in STEM and the role of teachers in helping remove these barriers.
8. Develop a continuing professional development (CPD) programme in STEM for early years educators, by the National Síolta/ Aistear Initiative (NSAI) Resource Development Group, to include an introduction to the issues regarding gender balance, equity and inclusion, in STEM. The inclusion of Arts in STEM will be considered as part of this development.
9. Pre-service and in-service teacher internships currently in place in Ireland should be further supported, promoted and scaled up as a facility for student teachers/teachers to experience STEM as it is applied in the workplace.
10. Research to be conducted into developing a model to incentivise broader participation and diversity in teaching through a range of criteria, including an investigation into STEM scholarships and options for STEM specialism at primary level.

SUPPORT EQUITABLE LEARNER ACCESS TO, AND EXPERIENCES OF, STEM TO INSPIRE LEARNING, FOSTER CREATIVITY AND PREPARE FOR LATER ENGAGEMENT AND SUCCESS

It is important that all learners have equitable access to STEM experiences in order to inspire learning, to foster creativity from an early age and to set the stage for their later engagement and success in these fields. It is especially important that young females can see people like themselves in STEM roles. The many programmes already underway can support greater confidence, a sense of belonging and self-awareness for young learners and the part they can play in STEM. However, increased access nationwide to meaningful STEM role models and/or career awareness activity that challenge stereotypes is required.

Awareness programmes that address gender balance in STEM careers targeting young people, parents/guardians and/or career guidance counsellors should be supported in addition to the building of knowledge-sharing networks.

Specific actions to deliver:

11. Increase equitable access nationwide to meaningful STEM role models and/or career awareness activity that challenge stereotypes. An evaluation of the provision already in place should be undertaken in order to make informed decisions on how to progress in this area. It is further recommended that the Department of Education should work with Science Foundation Ireland, under the SFI Discover Programme Call to progress in this area.
12. A pilot programme, *STEM Passport for Inclusion*, led by National University of Ireland, Maynooth, will recognise the experiences of girls from DEIS schools as they achieve micro-credentials in STEM, through mentoring and engagement with STEM content knowledge. The Advisory Group recommend engaging with this programme to assess its impact, with the potential to recommend further scaling of the programme if it is successful in its mission to break down barriers to girls in STEM.

SUPPORT SOCIETAL AND CULTURAL SHIFT TO ADDRESS CURRENT BARRIERS TO GENDER BALANCE IN STEM

Females in Ireland have access to the same educational and career opportunities as their male counterparts and are well-represented in many fields. However, although there has been some improvement in female representation in STEM areas over the years, they still remain significantly underrepresented. Negative stereotypes and beliefs remain, reducing the confidence of females in STEM early in their education. We must support a societal and cultural shift in removing these barriers.

Information must be readily available to our learners to include guidance on STEM subject choices for primary school children and their parents/guardians, in advance of the critical transition to post-primary school. Awareness of the diversity of STEM professionals, pathways and careers for learners must be made available to parents/guardians, teachers, guidance counsellors and school leaders.

Specific actions to deliver:

13. Develop guidance, starting with STEM subject choices, for primary school children and their parents/guardians that can be provided in advance of the critical transition to post-primary school.
14. Deliver, in partnership with SFI, stakeholders and industry, a large-scale engagement campaign for learners, parents/guardians, teachers, guidance counsellors and school leaders, to raise awareness of the diversity of STEM professionals, pathways and careers. This campaign will aim to challenge stereotypes in STEM.
15. The SFI Discover Programme Call should target activity that supports engagement with parents/guardians and require funded projects targeting parents/guardians to specify the form of engagement, the objectives of the engagement and to evaluate the outcome of the engagement. Furthermore, these projects will be required to share the outcomes achieved to grow awareness amongst the STEM engagement community of best practices and lessons learnt.
16. A study should be undertaken to identify programmes, both formal and informal, that are engaging with young people and their families to build STEM capital and to encourage consideration of further and higher education opportunities. The outputs should be used to identify how to establish broader access to such programmes, that are fit for purpose for the young people and families they serve.

Monitoring:

It has been noted by the Advisory Group that it is of utmost importance from the outset that implementation of the recommendations must be closely monitored and an evaluation process put in place. This will allow for the assessment of the appropriateness, efficiency and effectiveness of each of these, as well as providing the information to inform the future direction of the recommendations.

It is also noted that implementation of the recommendations will take time to effect change and it is suggested that there should be an annual review of the data on female participation in STEM, held by the Department, followed by a three-year and five-year marker, in order to ascertain if the recommendations are having an impact on STEM from early years to post-primary. While not the only mark of success, an uptake in the number of young learners participating across the STEM subjects, and taking these subjects at the Junior and Senior Cycle stage, should be one indicator.

Background to the Recommendations

The Gender Balance in STEM Education Advisory Group (the Advisory Group):

The terms of reference for the group are as follows:

- Assist the Department of Education in identifying key challenges to, and opportunities to promote, the uptake of STEM subjects at post-primary level (action 1.1.1 of the policy statement)
- Assess best practice methodologies to address key challenges and maximise these opportunities to promote the uptake of STEM subjects at post-primary level.
- Make recommendations for a co-ordinated response to these identified challenges and opportunities to include strategies such as pilot programmes (Action 1.1.2 of the policy statement)
- Consider potential means of removing barriers to STEM subjects offered by post-primary schools and make recommendations to address these barriers (Action 1.1.8 of the policy statement)

The Advisory Group will seek identification of actions for Phase 2 Implementation plan and oversight, development and delivery of these actions.

The work of the Advisory Group is informed by and contributes to other work relating to implementation of actions in the STEM Education Policy Statement and Implementation Plan.

THE GROUP MEMBERSHIP INVOLVED IN THE DEVELOPMENT OF THE RECOMMENDATIONS IS AS FOLLOWS:

Margie McCarthy (Chair)	Formerly Science Foundation Ireland, now SEAI
Catrina Carrigan	Teen Turn
Mary Cunneen	University College Dublin (<i>joined in September 2020, to represent Aoibhinn Ní Shúilleabháin during maternity leave</i>)
Merrilyn Goos	University of Limerick (<i>joined the group following the publication of the literature review in November 2020 and left the group in May 2021</i>)
Shalini Hollingum	CWIT (Connecting Women In Technology)
Dee Kehoe	Engineers Ireland
Áine Lynch	National Parents Council - Primary
Eilish McLoughlin	Dublin City University
Karen Murtagh	Department of Education
Aoibhinn Ní Shúilleabháin	University College Dublin
Paul Nugent	Santa Sabina Dominican College
Niall O'Connor	Ardgillan College (<i>Left the group in October 2020</i>)
Caroline O'Driscoll	iWISH

Marion Palmer
Maeve Price
Charles Tracy

WITS
Department of Education
Institute of Physics (*joined October 2020*)

As part of their remit the Advisory Group was tasked with developing recommendations to further Gender Balance in STEM education, from early years to post-primary level, by the Department of Education's STEM Education IAG. In the development of the recommendations, the group took into consideration the significant work, both formal and informal, that is already being undertaken across STEM education.

The Advisory Group commenced work by commissioning a Literature Review to identify a set of effective interventions for addressing Gender Balance in STEM in early years, primary and post-primary settings. It was agreed that while there were many interventions underway in Ireland, little was understood on what was effecting change. Following analysis of the report the group agreed that no single intervention will achieve gender equity, rather there is a requirement to support multiple interventions addressing different segments of the ecosystem to effect the change required. To address improving interest, engagement, self-perceptions and enjoyment of all learners, any gender inclusive strategy will require complementary interventions that address barriers arising in the home, in the education setting and in society at large.

At this point the Advisory Group were clear that good effort is underway throughout Ireland in addressing STEM skills, however there is much room for improvement, with gaps in activity and a need to view all the efforts collectively to ensure the sum of the parts is achieving the desired outcome.

Setting the recommendations:

A series of meeting of the group took place between January 2020 and July 2021. During this time progress slowed for a period due to the impact of the Covid-19 restrictions on the Department of Education and the members of the Advisory Group.

It was agreed by the group that success of the recommendations succeeding would result in easily identifiable:

- **Ecosystem alignment:** *Interventions targeting one barrier or level of the STEM ecosystem are aligned with other elements of the ecosystem.*
- **Curricular alignment:** *Curriculum coherence, articulation and implementation across transition points provides continuity for learners and scaffolding for extra-curricular interventions.*
- **Equity alignment:** *All students have equitable access to the widest range of STEM subjects in schools and to teachers who are appropriately qualified to teach these subjects.*