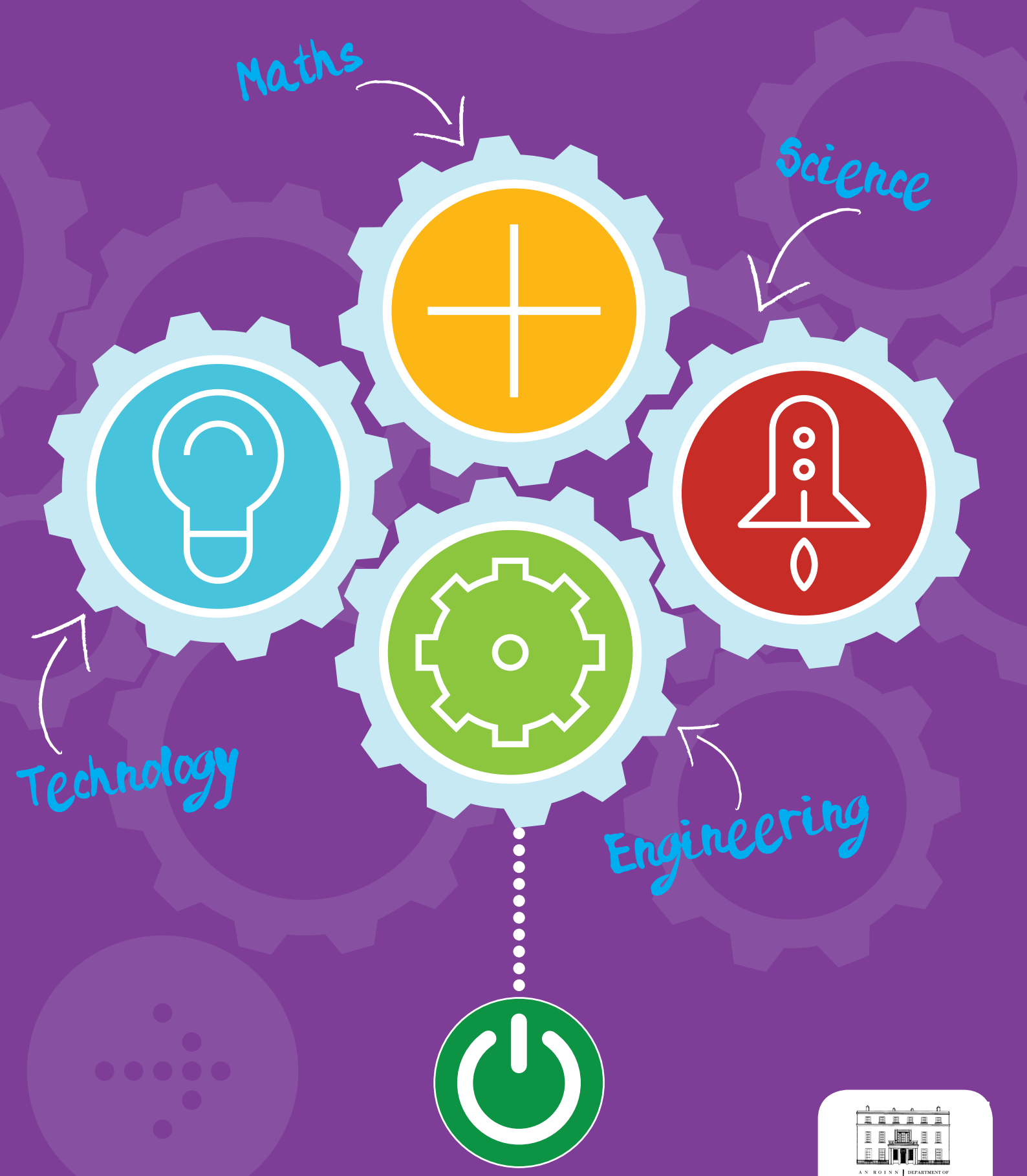
STEM Education

Policy Statement 2017–2026



AN ROINN OIDEACHAIS AGUS SCILEANNA
DEPARTMENT OF EDUCATION AND SKILLS

STEM EDUCATION POLICY STATEMENT

2017-2026

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FOREWORD

We have set ourselves the ambition that Ireland will become the best education and training service in Europe by 2026. Science, Technology, Engineering and Mathematics (STEM) are at the heart of a technological revolution which is transforming the way we live and the way we work. If Ireland is to be at the forefront of this transformation, we must be a leader in nurturing, developing and deploying STEM talent.

This Policy Statement focusses on the many strengths in STEM education while providing a roadmap to address the areas for development. This is a challenge that requires many stakeholders to work together. It is also about encouraging and inspiring more of our young people, particularly more females, to specialise in Science, Technology, Engineering and Mathematics during their education and training so as to open the doors to exciting and fulfilling jobs, careers and life opportunities.

In the Action Plan for Education (2017) I committed to the development of the STEM Education Policy statement with an accompanying Implementation Plan. The development has been informed by research, consultations and the *STEM Education in the Irish School System Report* published in November 2016. This Policy Statement acknowledges the areas for action and recommendations identified in the report, recognises the reforms currently underway in the Irish education system and explores how existing STEM activities and initiatives can be enhanced as well as incorporating new initiatives in order to maximise their impact.

This STEM Education Policy Statement and Implementation Plan sets an ambitious journey up to 2026. It will be dynamic and will constantly evolve to meet the challenges of the future. The actions in this Policy Statement will be implemented over three phases between 2017 and 2026. Implementation will be periodically reviewed, to ensure that it is responsive to the changing environment.

This Policy Statement contains challenging proposals which require commitment across the education system to achieve the stated ambitions. Success cannot be achieved by my Department alone, it identifies the collaborative action required between my Department and all relevant stakeholders to realise our vision for STEM education by 2026.

Richard Bruton T.D.
Minister for Education and Skills
27th November 2017

CONTENTS

1.	Introduction	5
2.	What We Mean by STEM Education	5
	Principles underpinning this STEM Education Policy Statement	9
3.	Why We Need a STEM Education Policy	10
4.	Ambition, Vision and Indicators of Success	12
5.	Pillars and Associated High-Level Actions	16
	Pillar 1. Nurture learner engagement and participation	16
	Pillar 2. Enhance teacher and early years practitioner capacity	16
	Pillar 3. Support STEM education practice	17
	Pillar 4. Use evidence to support STEM education	18
6.	Ensuring Effective Implementation	19
	Implementation Group	20
	Implementation Phases	21
Appendix 1: STEM Education Policy Development Process		22
Appendix 2: Membership of the STEM Education Steering Group		22
Appendix 3: Abbreviations		23
Appendix 4: Bibliography		24

1. INTRODUCTION

Science, Technology, Engineering and Mathematics (STEM) permeate every aspect of today's world, and the innovations that emerge from these fields underpin much economic development leading to the establishment of creative enterprises and rewarding careers. People working in STEM in Ireland are changing the face of the world we live in everyday, whether it is by making life-saving drugs and devices, researching new cures for cancer or creating new technologies that keep us healthier, safer and of course, entertain us[1]. Our education system plays a key role in equipping learners with the knowledge, skills and dispositions to effect these changes.

We need a national focus on STEM education in our early years settings and schools to ensure we have an engaged society and a highly-skilled workforce in place. This requires a clear understanding of STEM education for the Irish context. The embedding of this understanding across our education system will help transform the STEM education experience of learners from early years through to post-primary.

This *STEM Education Policy Statement* (Policy Statement) outlines

- What we mean by STEM education
- Why we need a STEM education policy
- Ambition, vision and indicators of success
- Pillars and associated high-level actions
- Ensuring effective implementation

This policy statement has been developed following extensive consultation with stakeholders, a review of national and international research and has also been informed by the *STEM Education in the Irish School System Report*[2]. A report[3] from the consultation process is available on the Department of Education and Skills website. Implementation will take place over three phases from 2017 – 2026.

2. WHAT WE MEAN BY STEM EDUCATION

STEM education is multi-faceted and goes well beyond the main disciplines that constitute the acronym STEM. 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.

[1] Smart Futures - What is STEM? www.smartfutures.ie
[2] STEM Education in the Irish School System; www.education.ie/en/Publications/Education-Reports/STEM-Education-in-the-Irish-School-System.pdf
[3] STEM Education Policy Consultation; www.education.ie/en/The-Education-System/STEM-Education-Policy

The four STEM disciplines[4] are Science, Technology, Engineering and Mathematics and may be summarised as follows

- **Science** enables us to develop our interest in, and understanding of, the living, material and physical world and develops the skills of collaboration, research, critical enquiry and experimentation
- **Technology** covers a range of fields which involve the application of knowledge, skills and computational thinking to extend human capabilities and to help satisfy human needs and wants, operating at the interface of science and society
- **Engineering** is about the design and creation of products and processes, drawing on scientific methods to provide the skills and knowledge to solve real-world problems
- **Mathematics** equips us with the skills needed to interpret and analyse information, simplify and solve problems, assess risk, make informed decisions and further understand the world around us through modelling both abstract and concrete problems

Within these four STEM disciplines there are a wide range of STEM subjects that learners can engage in during their school life. These can range from designing and making in primary school to Science, Technology, Engineering and Mathematics at post-primary. There is no definitive list of STEM subjects and recent consultations with teachers, parents and learners found considerable variance of views in this regard.

STEM education not only involves the teaching of these disciplines and subjects in isolation but also involves a cross-disciplinary approach. It builds on the content knowledge and understanding developed in and across the four disciplines, while acknowledging that all STEM learning activities are underpinned by Mathematics. It also recognises the strong linkage between STEM and Arts education which fosters design, creativity and innovation.

The reforms underway in the Irish education system recognise that young people require more than the ability to memorise facts and procedures. They must also be able to apply their creativity, knowledge and skills within and across disciplines and in real life situations. This requires our teachers to have sufficient pedagogical content knowledge, and expertise in assessment, to enable them to design and enact high-quality learning experiences. In the context of Cosán, the national framework for teachers' learning[5], it is essential that our teachers have accessible and high high-quality opportunities to facilitate them in maintaining their professional competence in a developing STEM environment. STEM education will provide learners with exciting opportunities and deep learning experiences that enable them to be resourceful and confident in engaging with STEM concepts in school and in their future lives.

Providing a high-quality STEM education experience

Engaging with high-quality STEM experiences at a young age can have a lasting impact on learners, as it can set the stage for their later engagement and success in these fields. Such experiences can encourage and support children to articulate and represent their explorations, discoveries, thinking and understanding which in turn can help build critical early STEM knowledge and skills. Building on this, the STEM education experience provides opportunities for learners, at each phase of their learning journey, to develop their STEM knowledge and skills in an integrated and engaging way.

[4] Definitions have been informed by Scottish Government STEM Consultation on a Strategy for Education and Training; http://www.gov.scot/Resource/0050/00509522.pdf
[5] Cosán; www.teachingcouncil.ie/en/Publications/Teacher-Education/Cosan-Framework-for-Teachers-Learning.pdf

Early Childhood themes, Primary priorities, Junior and Senior Cycle Key Skills											
Level 4	**Senior Cycle key skills**[6]	Critical and creative thinking		Communicating	Information processing		Being personally effective	Working with others			
Level 3	**Junior Cycle key skills**[7]	Managing information and thinking	Being Literate Being numerate	Communicating	Staying well	Being creative	Managing myself	Working with others			
Level 2	**Primary priorities**[8]	Develop thinking, learning and life skills		Communicating well	Be well		Engage in learning	Have a strong sense of identity and belonging			
Level 1	**Early childhood themes**[9]	Exploring and thinking		Communicating	Well-being		Identity and belonging				

FIGURE 1: THE STEM EDUCATION EXPERIENCE IN EARLY CHILDHOOD SETTINGS AND SCHOOLS

STEM education focuses on developing a range of Key Skills (Figure 1) that are essential for living and working in today's world. Learners will engage in a range of activities that include

- using their skills and content knowledge to creatively solve problems
- imagining, questioning and exploring
- collaborating with others
- engaging in inquiry and analysis
- innovating, designing and making
- testing and modifying their solutions to complex problems.

Such an approach requires the provision of systematic support for schools from the Department and from the broad range of stakeholders with an interest in STEM education. It will require strong leadership in early years settings and schools, to foster creativity in learning and to support the growth of a culture of scientific and technological innovation. STEM education is also supported by ongoing education reforms to provide our learners with a STEM experience that is relevant, meaningful, enjoyable and appropriately challenging.

The promotion of STEM learning within our education system is a key priority for the Department, and is reflected in multiple strategy documents, such as the *Action Plan for Education*[10], the *Ireland's National Skills Strategy*[11], the *Digital Strategy for Schools*[12], the *Arts in Education Charter*[13], and the *National Strategy: Literacy and Numeracy for Learning and Life*[14]. There is significant work already taking place around STEM education in areas such as curriculum and assessment reform, teacher professional development and the embedding of digital technologies in all classroom activities.

[6] Senior Cycle Key Skills Framework; www.curriculumonline.ie/getmedia/161b0ee4-706c-4a7a-9f5e-7c95669c629f/KS_Framework.pdf
[7] Junior Cycle Key Skills; www.curriculumonline.ie/Junior-cycle/Key-Skills
[8] Primary priorities: Through public consultation in 2011/2012 by the NCCA on the priorities for a primary education, six broad priorities were identified; http://ncca.ie/en/Publications/Reports/Priorities-for-Primary-Education.pdf
[9] Early Childhood themes; www.curriculumonline.ie/Early-childhood/Early-Childhood-Themes
[10] https://www.education.ie/en/Publications/Corporate-Reports/Strategy-Statement/Department-of-Education-and-Skills-Strategy-Statement-2016-2019.pdf and https://www.education.ie/en/Publications/Corporate-Reports/Strategy-Statement/Action-Plan-for-Education-2017.pdf
[11] Ireland's National Skills Strategy 2025; https://www.education.ie/en/Publications/Policy-Reports/pub_national_skills_strategy_2025.pdf
[12] Digital Strategy for Schools 2015-2020; https://www.education.ie/en/Publications/Policy-Reports/Digital-Strategy-for-Schools-2015-2020.pdf
[13] Arts in Education Charter; https://www.education.ie/en/Publications/Policy-Reports/Arts-In-Education-Charter.pdf
[14] National Strategy: Literacy and Numeracy for Learning and Life; https://www.education.ie/en/Publications/Policy-Reports/lit_num_strategy_full.pdf and https://www.education.ie/en/Publications/Education-Reports/pub_ed_interim_review_literacy_numeracy_2011_2020.PDF

This Policy Statement recognises that the provision of STEM learning experiences is not only confined to early years settings and schools. STEM learning opportunities present themselves in both formal and informal settings within an evolving eco-system (see Figure 2) and can take place, for example, in the home, in museums, at coding workshops or in industry. It also extends to the areas of further and higher education.

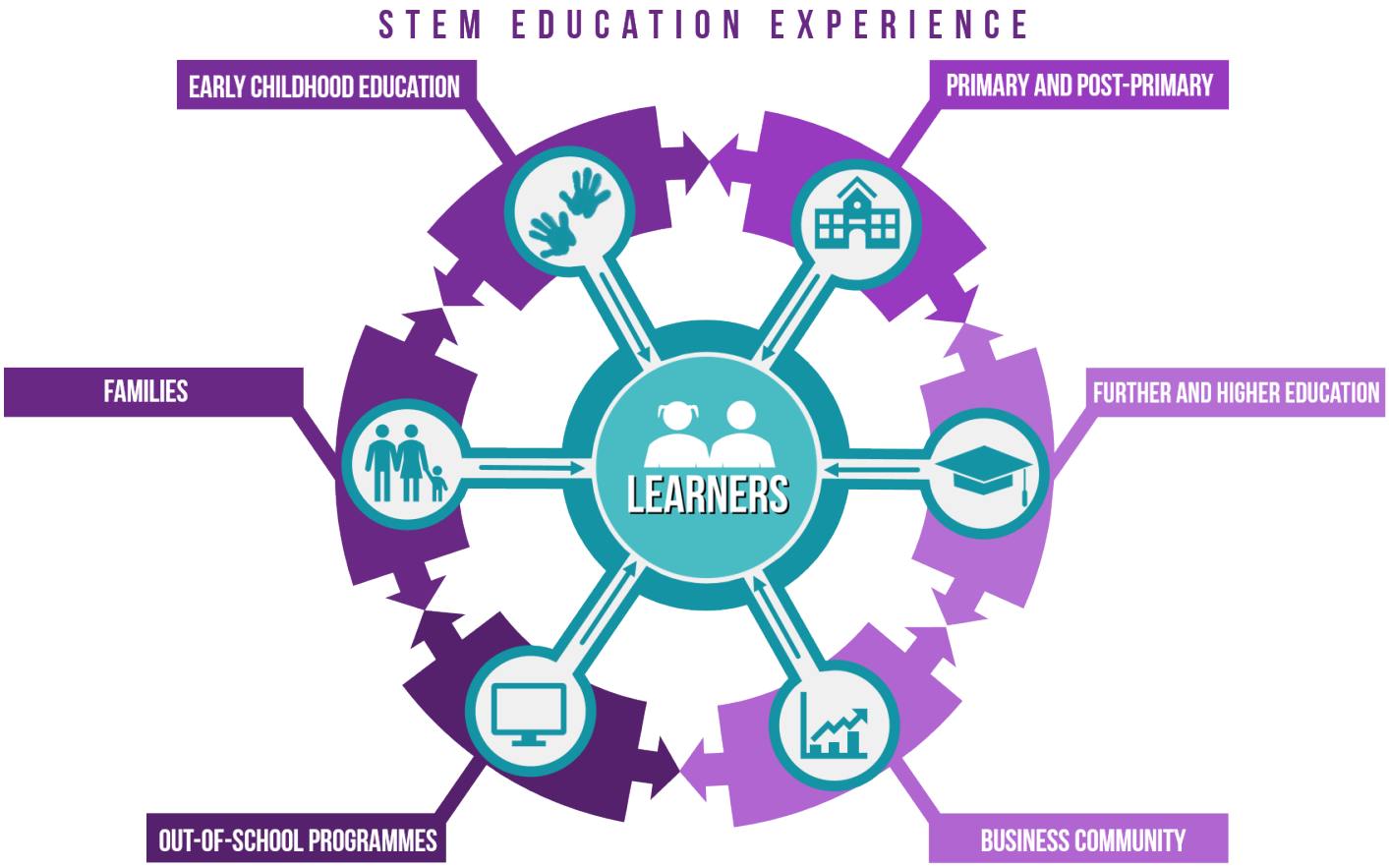

FIGURE 2: THE STEM EDUCATION ECO-SYSTEM

To sustain a supportive STEM education eco-system, all stakeholders will need to work together to develop a connected learning network. The importance of this collaboration will ensure that Ireland is better prepared to enable our people to succeed and our economy to prosper.

STEM learning in informal settings is delivered across a multi-stakeholder, multi-programme landscape with contributions from government departments and agencies, business and industry, professional bodies, science centres, community organisations and third level institutions. Bodies, including Science Foundation Ireland[15], support and promote engagement of the Irish public with STEM learning across informal settings which include competitions, exhibitions, science fairs, after-school clubs and STEM Weeks. There is a recognition that many of these activities are dependent on enthusiastic individuals and dedicated teachers to drive the initiatives.

This Policy Statement will bring greater cohesion to the diversity of STEM activity already taking place in our schools and communities, by recognising the role each stakeholder has to play in creating and maintaining an

[15] Science Foundation Ireland; www.sfi.ie

eco-system for STEM education. Multiple stakeholders have a role to play in supporting the STEM education experience of our young people so that we, as a nation, can overcome current misconceptions concerning ability and/or gender such as 'engineering is too hard' or that 'programming is not for girls'. Creating a sustainable STEM education eco-system is the responsibility of the wider society and will play a key role in enabling and encouraging learners to become active and responsible citizens.

Principles underpinning this STEM Education Policy Statement

In developing this Policy Statement, three key principles have been identified that will underpin all STEM education initiatives.

Principle	Descriptor
STEM is about igniting learners' curiosity so they participate in solving real world problems and make informed career choices.	• STEM education should encourage learners to be curious about the world they live in • STEM education should be relevant to the issues facing society • Learners should develop skills to enable them to be active citizens, ensure personal well-being, engage with modern communications and media in a critical way and make informed and ethical choices • STEM education should be for learners of all backgrounds, ability and gender • Learners should be enabled to make informed choices about careers in STEM and related areas
STEM is interdisciplinary, enabling learners to build and apply knowledge, deepen their understanding and develop creative and critical thinking skills within authentic contexts.	• STEM education should deepen conceptual understanding of and interest across multi-disciplinary fields, allowing learners to address global and societal issues • Learners should have opportunities to explore concepts and engage in problem-solving, while developing their knowledge and skills
STEM education embodies creativity, art and design.	• There are strong practical and creative components to STEM education that should provide learners with opportunities for real-world and inquiry-based tasks • Learners should have opportunities to design, create and make while exploring and experiencing STEM education

These principles will help guide the Department, schools, leaders, teachers and key stakeholders to play a proactive role in providing a high-quality STEM experience for our young people.

3. WHY WE NEED A STEM EDUCATION POLICY

The ongoing programme of reform in our education system is driven by a shared policy focused on better outcomes for all learners, raising standards of teaching, learning and assessment and school improvement. This Policy Statement recognises the importance of initiatives that raise awareness and interest in STEM among the public in Ireland to enable them to engage in informed STEM discussions. It also recognises the need to improve STEM education. Young people need to understand and be capable of using skills and concepts developed through STEM education to be active citizens, to engage with modern communications and media in a critical way, to ensure personal well-being and to make informed choices about many aspects of their lives.

STEM education is also highly relevant for our economic prosperity. International evidence shows that demand for STEM workers is expected to grow significantly between 2015 and 2025. While the demand is growing for workers with STEM skills, research has established that many of our learners are not adequately prepared to take up STEM related employment. The national five-year strategy, Innovation 2020[16], notes that the availability and quality of our graduates is essential for Ireland to maintain its attractiveness as a location for investment. Between 2010 and 2016 the number of STEM graduates has remained at approximately 24%, highlighting the need for an increase in people with STEM knowledge and skills at graduate level. There is also a need for an increase of people with STEM skills at apprenticeship level.

While the focus of this Policy Statement is on STEM from early years through to post-primary level, there are also important developments underway in relation to STEM in the higher education and further education sectors such as the *ICT Skills Action Plan*[17], *The Further Education and Training (FET) 2017 Services Plan*[18], the *Review of the Allocation Model for Funding Higher Education Institutions*[19] and actions relating to lifelong learning in the *National Skills Strategy*. These developments support the Policy Statement and highlight the importance of alignment in relation to STEM education across the entire education system.

While there are many strengths in STEM education provision in Ireland at present, a number of challenges also exist. These include the need to

- Ensure that Irish students' learning in STEM disciplines significantly improves, including the further development of skills such as problem-solving, inquiry-based learning and team working to address demands from the world of work
- Increase the number of students choosing STEM subjects in post-primary schools, those progressing to STEM pathways in Further or Higher Education and those who take up careers in STEM
- Increase participation of females in STEM education and careers
- Raise interest in, and awareness of the range of exciting careers in STEM
- Ensure young people sustain their involvement in STEM education

Performance of Irish students

Survey findings show that in general, Irish students' performance in international STEM assessments, specifically in Mathematics and Science, is above the average of students in developed countries. However,

[16] Innovation 2020; http://research.ie/assets/uploads/2017/06/Innovation-2020.pdf
[17] ICT Skills Action Plan 2014-2018; http://hea.ie/assets/uploads/2017/06/ICT-Skills-Action-Plan-2014-2018.pdf
[18] The 2017 Further Education and Training (FET) Services Plan; http://www.solas.ie/SolasPdfLibrary/FET%20Services%20Plan%202017.pdf
[19] Review of the Funding Allocation Model for Higher Education Institutions; http://hea.ie/assets/uploads/2017/06/hea_rfam_final_scoping_paper_012017.pdf

Irish students' performance is significantly weaker than that achieved by students in countries where STEM performance is outstanding. Their performance in the Trends in Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) shows that

- **TIMSS 2015**: At 4th Class in primary level, Irish students ranked 2nd in Mathematics out of the 22 participating EU member states/territories and 9th out of all 49 countries participating. Irish students ranked 10th in Science out of the 22 EU participating member states/territories and 19th out of all 47 countries.

  At post primary level, second year students ranked 1st in Mathematics out of the 8 EU participating member states/territories and 9th out of all 39 participating countries . In Science, Irish students ranked 3rd out of the 8 EU participating member states/territories and 10th out of all 39 participating countries[20].
- **PISA 2015**: In Science Irish students ranked 6th among EU member states/territories and 19th out of all countries participating. In Mathematics, Irish students ranked 9th among EU member states/territories and 18th out of all countries participating[21].

This data shows the progress that we are making in relation to STEM education and while it indicates encouraging trends. It is clear that there is still room for improvement in some areas if we are to achieve the ambition of being the best in Europe.

An analysis of the uptake of Mathematics in the Junior Cycle Examination, from 2012 to 2017, shows an increase in the proportion of students taking higher-level, from 52% in 2012 to just above 59% in 2017. The proportion of girls taking higher-level Mathematics in the Junior Cycle increased from 24% of the Mathematics cohort in 2012 to 29% in 2017.[22]

There has also been an increase in the proportion of students taking higher-level Mathematics in the Leaving Certificate in recent years. In 2017, 30% of Leaving Certificate students sat higher-level Mathematics, an increase of 8% from 2012. In 2017, 41% of the total cohort who sat higher-level Mathematics were girls, a decrease of 5% from 2012.

In 2017, 14% of all students sat Physics and 17% sat Chemistry at Leaving Certificate. Both Physics and Chemistry have shown a small increase in uptake from 2012 to 2017 (+1.3% and +3.6% respectively). With regard to uptake of Science subjects by girls at Leaving Certificate in 2017, almost 60% took Biology, while less than 20% took Physics or Chemistry.

The numbers of Leaving Certificate students taking Engineering in 2017 was 9% while in Technology the uptake was slightly less than 3%.

While the increased participation rates in certain STEM subject areas is to be welcomed, there remains a strong need to concentrate strategic initiatives on the uptake of STEM subjects at Leaving Certificate. This Policy Statement provides an overarching framework to address this ambition in a systematic way between 2017 and 2026.

[20] TIMSS 2015 in Ireland; http://www.erc.ie/wp-content/uploads/2016/11/TIMSS-initial-report-FINAL.pdf
[21] Future Ready? The Performance of 15-year-olds in Ireland on Science, Reading Literacy and Mathematics in PISA 2015; http://www.erc.ie/studies/pisa/publications/pisa-2015/
[22] State Examinations Statistics Information; www.examinations.ie/statistics

4. AMBITION, VISION AND INDICATORS OF SUCCESS

This Policy Statement sets out the ambitious areas for action considered necessary to achieve an improved STEM education experience and outcomes for learners from early years to post-primary school. Implementation will take place over three defined stages between 2017 and 2026. Realisation of the actions at each phase of implementation will require sustained effort and focus across each part of the education system and beyond including

- In early years settings
- In schools
- In Initial Teacher Education and in teachers' induction into the profession, and their ongoing learning thereafter
- In Science, Mathematics, Technology and Engineering provision/courses in higher and further education
- In informal learning
- In our arrangements for evaluation and quality assurance

The actions outlined for STEM education will build on a range of reforms and activities already underway such as curriculum reform and innovative teaching, learning and assessment. They are also informed by the *STEM Education in the Irish School System Report*, research and extensive consultation with stakeholders. Other influencing factors include parents' perceptions and expectations and the evolving STEM education eco-system.

Our vision for STEM education

> **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**

Central to this vision is the ambition to deliver systematic improvement across the continuum of education which will contribute to Ireland's future economic development. Learners, teachers, leaders, schools and society will benefit from a consistently improving vibrant and high-quality STEM education. In each of the following areas of ambition, Ireland will seek to match or exceed benchmarks of best European practice.

For learners

- Ireland will provide a high-quality STEM education experience that enables all learners, including those at risk of educational disadvantage and learners with special educational needs, to participate, influence and succeed in a changing world
- All learners will have an excellent understanding of STEM disciplines, methods and processes, and a positive attitude towards STEM education
- All learner achievement in DEIS schools will increase, thus addressing the gap in achievement in STEM disciplines between students in DEIS schools and students in all schools
- Uptake of STEM related subjects will increase for learners of all backgrounds, ability and gender, with a particular focus on uptake by females
- All learners will have access to high-quality information on STEM careers

For teachers and early years practitioners

- Teachers and early years practitioners will have an excellent understanding of STEM disciplines, methods and processes
- Building on cultures of collaborative professionalism, teachers and early years practitioners will provide effective and engaging STEM teaching, learning and assessment approaches
- Teachers and early years practitioners will provide collaborative environments, both in and out of school, for STEM learning, fostering curiosity, inquiry, persistence, resilience and creativity
- Teachers and early years practitioners will ensure the continuing development of their STEM pedagogical content knowledge and skills in and across the four disciplines
- Teachers and early years practitioners will share STEM practice in collaborative settings

For early years settings/schools

- STEM education will be an integral part of the culture, policy and practice of our early years settings and schools
- Leaders in all early years and school settings will foster a culture of scientific and technological innovation to promote creativity in STEM teaching and learning
- All early years settings and schools will be supported to establish relationships with STEM business and industry, public sector bodies, research organisations, further and higher-level institutions, and the wider STEM community
- All early years settings and schools will foster a culture of collaboration for professional learning in STEM education
- All schools will engage with parents, learners and the community in communicating the value of STEM education and STEM careers

For society

- Our citizens will be equipped with the relevant STEM skills and understanding to engage and lead in an ever-changing world
- Ireland will lead Europe in the education of a highly qualified and increasingly diverse STEM workforce
- Stakeholders will engage in a coordinated approach to provide a world standard STEM education eco-system
- Our citizens will be enabled to actively engage in informed STEM discussions
- The performance of Irish STEM learners across the education system will steadily improve and our ranking in cross country studies will rise
- Ireland will attract a growing proportion of school leavers into STEM studies and careers

In each of these areas of ambition, demonstrable improvements will be made. One of the immediate areas of work will be to identify stretch targets with associated benchmarks and key performance indicators. Progress towards the achievement of our ambitions will be realised through a strategic planning process, developing and monitoring new initiatives and learning from best practice at home and abroad. The areas of policy development and action span four pillars as follows

Pillar 1. Nurture learner engagement and participation

Pillar 2. Enhance early years practitioner and teacher capacity

Pillar 3. Support STEM education practice

Pillar 4. Use evidence to support STEM education

Success in these areas of policy development and action will result in the following outcomes by 2026

Outcomes for Pillar 1. Nurture learner engagement and participation.

- All early years settings, schools, leaders, parents, teachers and learners will have a high awareness of the importance of STEM education
- Research and monitoring of the uptake of STEM subjects by all learners in post-primary schools in place
- Uptake of Leaving Certificate Chemistry, Physics, Technology and Engineering to increase by 20%
- Uptake of STEM subjects by females to increase by 40%
- Quality career information available to all schools for learners and parents
- Increased partnerships between schools, business and industry, public sector bodies, research organisations, further and higher-level institutions, and the wider STEM community.

Outcomes for Pillar 2. Enhance teacher and early years practitioner capacity.

- A quality assured programme of STEM professional development will be provided to all early years practitioners, primary teachers and to all relevant teachers in post-primary schools
- Teachers and early years practitioners will have engaged with professional learning opportunities and will embed STEM into their teaching practice to include the use of digital technologies

- Teachers and early years practitioners will adopt an inquiry-oriented approach to their teaching and learning, and their practice will be informed by their engagement in and with relevant research
- Teachers and early years practitioners will use a cross-disciplinary approach incorporating pedagogical content knowledge and understanding developed in and across the four disciplines
- All programmes of teacher education across the continuum will take account of the STEM Education Policy Statement
- Robust relationships between schools and HEIs, research agencies, business and industry, professional bodies, science centres, media and government agencies are in place.

Outcomes for Pillar 3. Support STEM education practice.

- Teachers and learners will have access to relevant, high-quality and up-to-date curricula across all of the STEM subjects and areas at early years, primary, junior cycle and senior cycle levels
- Early years practitioners and teachers in early years setting and schools will have ready access to examples of highly effective practice in STEM education through
  - advisory visits from the Department's Inspectorate and support services
  - online materials and publications
  - professional networks and online communities of practice
- STEM practice will be supported through individual and collective reflection, through school self-evaluation and focussed inspection in schools and early years settings
- Learners have access to co-curricular and out-of-school STEM learning opportunities with a 20% increase in extra-curricular STEM activities in schools in every region
- STEM awards for Primary and Post-Primary schools in place
- Partnerships in place with Arts education promoting creativity, universal design and design thinking skills into all STEM learning experiences
- Partnerships in place with business, industry and the research community.

Outcomes for Pillar 4. Use evidence to support STEM education.

- STEM education research available to include best practice in STEM teaching, learning and assessment, rates of participation, attainment, attitudes to STEM, graduate numbers and STEM related skills
- Review mechanisms in place for established STEM education programmes and trials
- Quality in STEM education will be reported upon regularly by the Department's Inspectorate.

Achievement will be in three phases

Phase 1: 2017-2019, Enhancing
Phase 2: 2020-2022, Embedding
Phase 3: 2023-2026, Realising

An Implementation Plan for each phase with high-level actions and sub-actions within designated timeframes will be produced.

5. PILLARS AND ASSOCIATED HIGH-LEVEL ACTIONS

The four pillars of STEM policy development and action identified will support the realisation of our vision of providing a high-quality STEM education experience that nurtures curiosity, inquiry, problem-solving, creativity, ethical behaviour, confidence and persistence, along with the excitement of collaborative innovation. Objectives and high-level actions are set out under each of the pillars. The supporting Implementation Plan will further break down each of the high-level actions into sub-actions.

Pillar 1. Nurture learner engagement and participation

Nurturing young people's STEM curiosity starts from early childhood and continues throughout their learning journey. Our education system has a responsibility to ensure that all learners are provided with a high-quality STEM education experience that creates a positive disposition towards STEM and enables them to participate, influence and succeed in a changing world.

We must ensure that learners have a positive engagement with STEM education, while also increasing the uptake of STEM related subjects for learners of all backgrounds, ability and gender. High-quality advice on the importance and relevance of STEM skills and information on the range and diversity of STEM related career opportunities is required for schools, learners and parents.

There is a need to engage in STEM awareness campaigns and the promotion of STEM careers through programmes such as Smart Futures[22].

The following objectives and high-level actions are designed to nurture learner engagement and participation in STEM education

Pillar 1. Objectives and High-Level Actions

Objective	High-Level Action
Increasing participation of learners in STEM education	• Increase uptake of STEM subjects for learners of all backgrounds, ability and gender
Increasing awareness of STEM education	• Undertake awareness programmes that promote STEM • Enhance support for learners to make informed choices about STEM higher and further education and training options

Pillar 2. Enhance teacher and early years practitioner capacity

Improved teacher capacity is a key enabler in delivering STEM education of the highest quality for our learners. STEM education recognises the need for children from early childhood to have multiple and varied opportunities in STEM exploration and discovery. Teachers and early years practitioners require STEM subject matter knowledge, pedagogical content knowledge, appropriate skills and confidence. Enhanced preparation, development and support, through high-quality training, Initial Teacher Education, induction and ongoing professional learning is required. We must ensure that teachers, early years practitioners and leaders are provided with the necessary professional supports and opportunities to enable them to achieve this.

Increased learner uptake and development of new STEM related options in schools will require teachers to expand on existing STEM learning experiences. We must ensure that we have sufficient capacity within the teaching and early years profession to respond to current and future developments.

The following objectives and high-level actions are designed to enhance the STEM knowledge and practice of teachers and early years practitioners during their initial education and throughout their careers. These supports are intended to enrich current and future classroom practices.

Pillar 2. Objectives and High-Level Actions

Objective	High-Level Action
Enhancing the capacity and quality of teacher education to support STEM education in schools	• Enhance the quality of Initial Teacher Education, induction and ongoing learning opportunities to support the development of STEM disciplines and pedagogical content knowledge • Develop guidelines to facilitate STEM education in school placement in Initial Teacher Education • Facilitate effective partnerships between Initial Teacher Education, teachers' learning providers, STEM research and business and industry
Building early years practitioner and teacher capacity through continuous improvement	• Ensure STEM education professional learning and mentoring is included in teacher induction • Ensure the ongoing provision of teachers qualified to teach STEM specific subjects at post-primary • Provide a variety of high-quality STEM related opportunities for early years practitioners and teachers to support their own professional learning • Provide support to teachers in relation to implementation of STEM education curricular change • Promote collaboration on STEM education within and between school settings • Conduct an ongoing review of the standards and quality of STEM education professional learning

Pillar 3. Support STEM education practice

There is a need to enrich teaching, learning and assessment practices from early years to post-primary to ensure that learners of all backgrounds, ability and gender are equipped with the skills needed to participate in our changing world. It is essential to place the needs of the learner at the core of teaching, learning and assessment to ensure a positive attitude to STEM education. Schools and early years settings must continually evolve, improve and learn from best practice in relation to STEM education.

We must embrace the changes required in our approach to STEM teaching, learning and assessment if we are to improve learning experiences and outcomes. We must enable learners to become active and reflective participants by providing a range of learning and formative assessment experiences that enhances their curiosity, inquiry, creativity and problem-solving abilities. In addition there is also a need to provide out-of-school STEM learning opportunities to further deepen learners knowledge and interest.

Effective leadership, at both early years and school level, is required to build a STEM culture and enhance the capacity of STEM education. Leaders must develop, support and review STEM teaching, learning and assessment practices and develop strong relationships with early years practitioners, teachers, learners, parents and the wider STEM community. Partnership with business, industry and the research community will also be important. Evaluation systems, both internal school self-evaluation and external, should promote highly effective practices so that STEM education is provided at the highest levels.

The following objectives, and high-level actions, are designed to enhance the STEM education practices in early years and schools

Pillar 3. Objectives and High-Level Actions

Objective	High-Level Action
Enhancing STEM teaching, learning and assessment practices in early years settings and schools	• Provide for ongoing STEM related curriculum review, development and assessment • Provide access to high-quality curricular materials for STEM related subjects and courses • Provide opportunities for all learners to participate in STEM education through informal, co-curricular and extra-curricular programmes • Support early years and school leadership to enhance STEM education • Support the evaluation of STEM education at early years and school level
Enhancing STEM teaching, learning and assessment practices using digital technologies	• Provide for digital technologies to support STEM education
Enhancing the link between STEM education and the Arts	• Include provision for STEM education in the national research repository for Arts • Provide for STEM education linkages in Arts education partnerships
Enhancing partnership between schools and business and industry and the research community	• Provide supports for schools to establish links with business and industry, HEIs and the research community more broadly

Pillar 4. Use evidence to support STEM education

Building and sustaining a vibrant STEM education eco-system for all learners will require ongoing innovation in STEM education. Such innovation should be underpinned by evidence generated through STEM research which can identify successful pedagogical strategies, inform school practice and contribute to the ongoing development of curriculum, policy and teacher education. Building on the already active STEM education research community in Ireland, a new STEM education research model would provide for engagement in funded research with collaboration across all levels of education.

The adoption of an evidence-led approach to STEM education will assist the Department in implementing and informing future policy decisions. Identification of STEM baseline data will underpin this. It will also involve monitoring the impact of programmes and initiatives, both formal and non-formal, to improve STEM outcomes across our education system.

The following objectives and high-level actions are designed to build a research base, facilitate the use of evidence to support STEM education, and create a culture of innovation in STEM teaching, learning and assessment

Pillar 4. Objectives and High-Level Actions

Objective	High-Level Action
Using evidence to support STEM education	• Develop a model to support the STEM education research community in Ireland • Support evidence-based research to inform STEM education provision, curriculum, pedagogy, professional learning and future policy development • Identify and provide annual STEM data indicators on participation, attainment, attitudes to STEM, graduate outcomes and STEM related skills needs • Develop innovative responses to skills gaps to meet national and regional STEM related skills needs • Explore the provision of bonus points in STEM-related Higher Level Leaving Certificate subjects (in cases where students apply for higher education courses in STEM-related areas) by the HEIs, in consultation with the Transitions Reform Steering Group.

6. ENSURING EFFECTIVE IMPLEMENTATION

This Policy Statement is a living document, containing challenging proposals which require commitment across the education system to achieve the stated ambitions. It identifies the key areas where collaborative action between the Department and all relevant stakeholders will be required to realise our vision for STEM education by 2026.

The Department will lead on the implementation of this policy at a national level. The role of Department agencies, state funded bodies and other stakeholders is key to ensuring the policy is implemented across the system.

The Department will

- Ensure that appropriate commitments are contained in the Performance Delivery Agreements and Frameworks with relevant bodies and education providers
- Support a range of initiatives as part of a balanced STEM education experience for all learners
- Promote STEM innovation and creativity across the education system and address barriers, deficits and shortfalls

This Policy Statement recognises the importance of the commitment of schools and early years settings and the requirement to support them to do this work. Sustained investment, to include quality assured professional learning opportunities, including programmes and supports for early years practitioners, teachers and leaders will be required over the implementation period.

The NCCA will design subject specifications having regard to this Policy Statement, while the State Examinations Commission will support models of assessment to complement its objectives.

The commitment of the Teaching Council (the Council) is central to embedding this Policy Statement through the continuum of teacher education. Through the review and professional accreditation of Initial Teacher Education programmes and through the Droichead[23] Induction programme, the Council will ensure that teachers have the knowledge, skills and competencies required to provide a quality STEM education for learners. The Council recently published Cosán[24], the national framework for teachers' learning, and this work is currently the subject of a development process. In this way, the Council oversee the processes which will enable us to ensure that teachers develop the knowledge, skills, attitudes and dispositions to provide quality STEM education for learners.

Higher Education Institutions and providers of programmes of Initial Teacher Education have a responsibility to take account of this Policy Statement to ensure programme graduates have the necessary STEM skills and pedagogical content knowledge as they embark upon their career in teaching.

The Department's Inspectorate will, through its evaluation and advisory processes, provide positive support for a quality STEM education for learners. This will include advice and guidance to schools about using school self-evaluation, school planning and collaborative professional working within schools to improve STEM education, and a range of evaluation approaches to monitor and report on the quality of STEM education.

Science Foundation Ireland[25], will contribute to actions under the Policy Statement as part of its remit to promote and support education, engagement and study in the areas of STEM as well as promoting an awareness and understanding of STEM to society and in particular the growth of the economy.

Business and industry will engage in partnerships with schools with a focus on how they can best support STEM education in our schools and provide learners with an insight into how STEM learning can develop into a career in STEM.

Effective realisation of this Policy Statement and Implementation Plan will depend on the availability of resources to ensure that actions are carried out. Budget 2018 provided an allocation of an additional €1.5 million to support implementation. The allocation for further years will be addressed in the context of the budgetary process.

Implementation Group

The implementation of this STEM Education Policy Statement will be led and coordinated by the Curriculum and Assessment Policy Unit in the Department. The Unit will report regularly to Senior Management and the Minister on progress. An expert STEM Education Implementation Group will be established by the Department to oversee this work. Each year the programme of actions will be reviewed by the Implementation Group, the Department and its agencies to ensure that significant progress across the key areas of ambition is being delivered.

[23] Droichead; www.teachingcouncil.ie/en/Teacher-Education/Droichead
[24] Cosán; www.teachingcouncil.ie/en/Publications/Teacher-Education/Cosan-Framework-for-Teachers-Learning.pdf
[25] Science Foundation Ireland is under the aegis of the Department of Business, Enterprise and Innovation; www.sfi.ie

Implementation Phases

This Policy Statement will be implemented in three phases between 2017 and 2026. The objectives, high-level actions and sub-actions will be subject to refinement and development by the Department as implementation proceeds. This Policy Statement contains challenging proposals which require committed support across the education system to achieve the stated ambitions.

An Implementation Plan will be developed for each of the implementation phases and will detail timelines and responsibilities. All action planning will be supplemented by research and analysis of data to ensure that all targets and benchmarks to be used in each of the phases of implementation of this Policy Statement are in line with the changing educational environment. Monitoring and review of the actions in each phase will inform the Implementation Plan for subsequent phases.

Implementation Phase 1: 2017-2019 – Enhancing

Phase 1 will seek to accelerate activity already underway in key areas. It will also seek to build capacity across the system and develop new initiatives. Initiatives from schools themselves through clusters and partnerships will be particularly encouraged. Audit and evaluation of key methods that are crucial to achieving our ambition and developing the benchmarks of success will be undertaken.

Phase 1 will focus on establishing what is necessary to provide a quality STEM education experience. Key to this is the analysis of existing baseline data and the generation of new benchmarks to develop targets and indicators which are well-defined, realistic and time-bound.

Implementation Phase 2: 2020-2022 – Embedding

The focus of Phase 2 will be on deepening capacity building and supporting a coherent STEM environment. A structured approach, which incorporates monitoring and review, will allow actions to be revised and developed in line with identified needs.

Implementation Phase 3: 2023-2026 – Realising

Phase 3 will focus on realising the vision of providing the highest quality STEM education experience for learners. Actions in phase 3 will be informed by reviews of Phases 1 and 2, ongoing research and the changing educational and societal environment.

This Policy Statement sets out a phased approach to the promotion of STEM Education, with the aim of helping learners become engaged, creative and critical thinkers, global citizens and active resilient learners in a changing learning environment.

APPENDIX 1

STEM Education Policy Development Process

In November 2016, the *STEM Education in the Irish School System Report* (STEM Report) was published. This report identified a range of recommendations to ensure that STEM education of the highest quality is provided to our young people. Following on from this, the Department formed the STEM Education Steering Group to direct and support the development of a STEM Education Policy Statement and Implementation Plan. An intensive stakeholder consultation process was carried out in the period April to June 2017.

The consultation process included

- Focus groups with learners, teachers, and parents from a range of primary and post-primary schools
- A consultation event with representatives from Initial Teacher Education, Third Level Research, Teacher Unions and Representative Bodies, the DES Support Services, other Government Departments and the STEM business and industry
- Over 600 online submissions from various representative bodies and individuals

The Department in developing this Policy Statement has been informed by the STEM Report, the consultation process, existing strategies and action plans, and international best practice.

APPENDIX 2:

Membership of the STEM Education Steering Group

Name	Organisation
Gary Ó Donnchadha (Chairperson)	Department of Education and Skills
Dr Aoibhinn Ní Shúilleabháin	School of Mathematics and Statistics, UCD
Seán Fogarty	Irish Science Teachers Association
Margie McCarthy	Science Foundation Ireland
Don O'Connor	Department of Business, Enterprise and Innovation
Jane O'Hanlon	Poetry Ireland
Dr Anna Walshe	National Council for Curriculum and Assessment - Post Primary
Dr Derek Grant	National Council for Curriculum and Assessment – Primary
Dr Eoghan Ó Faoláin	IBEC
Seán Ó Broin	State Examinations Commission
Eamon Clavin	Department of Education and Skills Inspectorate - Primary
Noreen McMorrow	Department of Education and Skills Inspectorate - Post Primary
Eamonn Moran	Curriculum and Assessment Policy Unit, Department of Education and Skills
Eddie Ward	Teacher Education Section, Department of Education and Skills
Seamus Knox	Inspectorate and Teacher Education Section, Department of Education and Skills
Karen Murtagh	Curriculum and Assessment Policy Unit, Department of Education and Skills

John Hurley and Dr. Michael Hallissy of H2 Learning facilitated the policy analysis, public consultation and development of the Policy Statement and Implementation Plan.

APPENDIX 3:

Abbreviations

DEIS	Delivering Equality of Opportunity in Schools
EU	European Union
FET	Further Education and Training
HEI	Higher Education Institution
ICT	Information and Communications Technology
IBEC	Irish Business and Employers Confederation
PISA	Programme for International Student Assessment
SFI	Science Foundation Ireland
STEM	Science, Technology, Engineering and Maths
TIMSS	Trends in International Mathematics and Science Study

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