Irish National Teachers' Organisation
Cumann Múinteoirí Éireann

INTO Submission to the Joint Committee on Education, Further and Higher Education, Research, Innovation and Science

The Future of Science, Technology, Engineering and Mathematics (STEM) in Irish Education

February 2023

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Introduction

The Irish National Teachers' Organisation is the oldest and largest teachers' trade union in Ireland. It represents almost 50,000 teachers at primary level in the Republic of Ireland and primary and post-primary level in Northern Ireland. The INTO would like to thank the Joint Committee on Education, Further and Higher Education, Research, Innovation and Science for the opportunity to discuss the Future of Science, Technology, Engineering and Mathematics (STEM) in Irish Education.

In January 2022 the INTO made a submission to the Department of Education as part of the Department's Consultation of Phase 2 of the STEM Education Implementation Plan.

The Department of Education's STEM Education Policy Statement (2017–2026) provides a national focus on STEM education in early years settings and schools and identifies the goals and actions required to achieve and improve the STEM education experience and outcomes for all learners. It sets out an ambitious journey up to 2026 which will be dynamic and evolve to meet the challenges of the future, with a vision to provide "*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 INTO welcomes this opportunity to contribute further to the consultation and discussion around STEM Education.

The foundations for Science, Technology, Engineering and Mathematics (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 STEM subjects. Young children naturally engage in early STEM exploration through hands-on multisensory and creative experiences. By engaging in these experiences, children are developing curiosity, inquisitiveness, critical-thinking and problem-solving capacities which are built on throughout their primary and post-primary school education.

Such is the rapid pace of change and technological developments that it is predicted more than 60% of children attending school today will work in a career that does not currently exist (OECD, 2019). Science, Technology, Engineering and Mathematics are key enablers for the Irish economy and for the development of important skills and competencies in our young people.

Outcomes of the Trends in Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA) provide a benchmark against which to gauge our STEM education outcomes. The TIMSS 2019 study stated that at fourth class level, out of the 22 participating European Union (EU) member states/territories, no EU countries ranked above Irish students in Mathematics. Irish primary school pupils ranked 8th out of all 50 countries participating. Irish students ranked 5th in science out of the 22 EU participating member states/territories and 13th out of all 48 countries participating. These results reflect a stable performance since TIMSS 2015.

The Inspectorate's evaluation of the implementation of the first phase of the STEM Education Policy Statement 2017-2026 provides some interesting insights into how STEM education policy is being implemented at school and Early Learning and Care (ELC) level. The Inspectorate's report, based on a sample of ELC settings plus primary and post-primary schools during the period January 2019 to December 2019, provides a benchmark for the education system and policy makers and will be helpful in informing actions that may need to be taken to ensure that national STEM education objectives can be achieved.

Learners' engagement with Science, Technology, Engineering and Mathematics (STEM)

The Irish Primary School Curriculum strives to promote the holistic development of the child, with its focus on the development of learners' skills, knowledge, and dispositions in an integrated, cross-curricular way. Children are naturally curious, therefore science in primary school should nurture this curiosity and allow them to ask questions and develop the skills they need to find an answer. Primary school science currently encompasses the content strands of Living Things, Energy and Forces, Materials, and Environmental Awareness and Care, and specifically supports the development of skills related to 'designing and making' and 'working scientifically'. These include questioning, observing, predicting, investigating, and experimenting, estimating and measuring, analysing, recording and communicating.

Overall, where learner engagement and achievement in STEM is most effective at primary level, pupils are enabled to explore, investigate and to create using thematic or cross-curricular approaches that encompass a variety of subjects, activities, and approaches. This was evident in the findings of the STEM report 2020, which found that schools were very aware of the importance of STEM education and there was often a clear articulation by schools of the importance, value, and opportunities that STEM education holds for pupils. Whilst this was particularly prevalent at post-primary level, INTO welcomes the finding that 88% of primary schools visited were deemed to be 'very aware' of the national STEM education agenda.

Teachers' engagement with STEM education methodologies

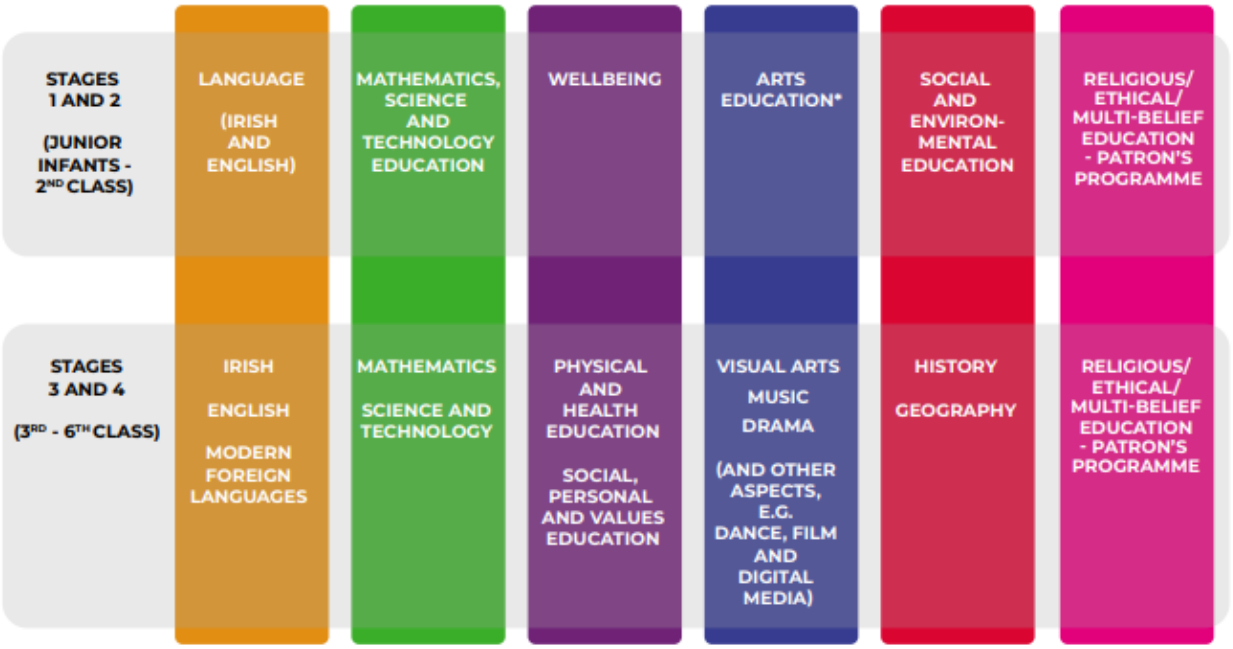
Findings of this research in relation to teachers' and practitioners' engagement with, and use of STEM pedagogies in the 2020 report were positive, with more than four out of every five STEM lessons at primary level (and at post-primary level) deemed to be 'satisfactory' or better.

Where high-quality STEM teaching was observed at primary level, it was often characterised by children's agency in their own learning, their use of the environment to engage in exploratory activity and opportunities to experiment with natural and other materials.

At system level, significant work in STEM education is underway in areas such as curriculum and assessment reform, teacher professional development and the embedding of digital technologies in all classroom activities. In addition to these developments, the INTO identifies other key issues that must be addressed to ensure that the STEM Education Policy Statement can realise its ambition and that *"Teachers and early learning and care practitioners can engage with professional learning opportunities and embed STEM into their teaching practice to include the use of digital technologies".*

Primary Curriculum Developments

Our current Primary Curriculum is the oldest in Europe and the process of developing a new Primary Curriculum Framework is underway. The Framework envisages that the Primary Curriculum will be presented in five broad curriculum areas, one of which will be STEM.



Mathematics, Science and Technology Education supports children's capacity to understand and engage fully with the world around them. Mathematics provides the foundation for science and technology. Science and technology are intrinsically linked and enable children to benefit from learning about, and working with traditional, contemporary and emerging technologies. They also enable children to develop an interest in and understanding of the biological, material and physical world by exploring and investigating scientific concepts and processes (NCCA 2020).

During an INTO consultation with members on the Draft Primary Maths Curriculum in 2022, some members expressed concern at the grouping of mathematics with science, technology and engineering. Teachers emphasised the importance of ensuring that sufficient, distinct time is allocated to Mathematics due to the crucial importance of the development of foundational numeracy and maths skills in the early years of primary school (INTO 2022).

Recommendations for the Future of Primary STEM

Class Size: Large classes at primary level are a barrier to the successful implementation of any curriculum subject. The nature of STEM is such that it demands discovery-based learning and inquiry-based, constructivist pedagogies. A reduced pupil–teacher ratio is a prerequisite for such active pedagogies. While the staffing schedule for primary schools has reduced by one pupil per mainstream teacher for the last three years, Ireland's primary school classes remain three pupils per class above the EU average. We must continue to lower class size in Ireland.

Funding for Schools: There is a need to support schools in the reimagining of creative spaces where STEM education methodologies and STEM based learning can thrive. Creative spaces should be provided in all schools and resourced accordingly. For this, increased investment in primary education is essential.

Continuous Professional Development: It is imperative that both practicing, and student teachers are provided with the training and Continuous Professional Development (CPD) to upskill in the ever-evolving area of STEM education. The INTO recommends that CPD for STEM should be provided on a continual, planned and well-resourced basis, focussing on a whole-school approach which supports a school's local context, environment and interests.

School Leadership/ Posts of Responsibility: The full restoration of middle-management posts in primary schools would afford them the opportunity to delegate STEM-related preparation for teaching and learning (including the organisation of whole-school projects and activities) to an in-school management team member.

Integration: Whilst the 2020 STEM report promotes integrated experiences of STEM education to enhance pupils' learning experience, the challenge that this poses curriculum delivery is recognised. The Draft Primary Curriculum Framework, recently approved by the Minister, seeks to support a more integrated approach to teaching and learning. The NCCA and other stakeholders must bear this in mind in the development of a coherent curriculum.

Outdoor Learning: Outdoor learning provides children with an opportunity to experience the interdisciplinary nature of the real world through interactions with each other and the planet. The value of exploration of the natural world and pupils' environment is reiterated in the National Council for Curriculum and Assessment (NCCA) Draft Primary Curriculum Framework (2020). Sufficient investment must be provided to develop outdoor spaces in schools to facilitate the interdisciplinary nature of STEM.

Links with the Community: Strong links with local industries, educational institutions and community groups are effective in enriching STEM education at school level. Opportunities for schools to support community efforts in advancing local projects across early childhood, primary and post-primary curricula should be promoted. INTO is currently undertaking research on transitions from early years settings to primary school and the area of STEM offers an opportunity for both settings to work collaboratively.

Gender Equity: Gender stereotyping, curriculum accessibility and resourcing are all contributory factors to Ireland's high gender differential between male and female STEM graduates. Gender-responsive STEM education must be encouraged to provide all children and young people with scientific and technical knowledge and skills that can be applied to real-life contexts, strengthen agency, and enable critical understanding of social and environmental issues in the world around them.

Pupil Voice: It is an underlying principle of the curriculum that the child should be an active agent in his or her own learning. The INTO welcomes the NCCA's recent consultation with children and young people on STEM. In preparing for the teaching and learning of STEM, pupils' interest and prior knowledge must be considered and their active participation encouraged.

Artificial Intelligence (AI) Skills/Assistive Technology: Information and communication technology has brought profound changes to all aspects of our lives. While the European Commission considers it paramount that children learn about AI from an early age, the 2022 Report on AI skills notes that while almost everyone will need some knowledge or understanding of AI as it becomes embedded into our lives, high-level, technical, AI skills will be needed only by a minority of people. To support the skills needed *"educators will need to be ahead of the curve"*. Schools will be required to deliver a grounding in digital skills across the board and must be resourced and supported to do so.

INTO also notes that the use of assistive technology has contributed to a transformation of the learning experiences of children with special educational needs (SEN). INTO believes that in an increasingly digitised world, enhanced access to assistive technology for pupils with special educational needs is paramount to support inclusion.

Conclusion

STEM subjects are relevant in our everyday lives, accentuating the need to ensure effective education in this area from outset in early years education. During the Covid-19 crisis, young people demonstrated their STEM knowledge and skills to assist their communities. In some post-primary schools across the country, students, for example produced much-needed PPE. This work shows that an integrated approach to science, technology, engineering, and mathematics can have a positive impact on our lives. As the world we live in continues to change and advance, we will be confronted with numerous other challenges and unknowns. It is vital that we equip our young learners with the STEM tools that will enable them to tackle these obstacles in a problem-solving, solution-focused approach. Teachers are committed to providing the best possible outcomes for their pupils, both now and in the future. To cultivate an enriching learning environment, teachers need relevant curricula and the tools to empower their pupils. To achieve this, appropriate resources and funding are vital. The INTO calls for increased investment by government to ensure that all teachers in our primary schools are provided with appropriate professional development and supports to realise the ambitions within Ireland's National STEM Policy.

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