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Iúil 2023

Joint Committee on Education, Further and Higher Education, Research, Innovation and Science

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

July 2023

33/ES/16

MEMBERSHIP

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CATHAOIRLEACH'S FOREWORD

The Joint Committee on Education, Further and Higher Education, Research, Innovation and Science identified the Future of Science, Technology, Engineering and Maths (STEM) in Irish Education as a key priority issue.

The Joint Committee agreed to produce a report having identified the following key Modules:

- STEM in Primary Education.
- STEM in Post-Primary Education.
- STEM in Tertiary Education.
- Female Participation, Diversity and Inclusion in STEM.
- Digital Strategy in Education to Support STEM.

The Committee sought and received written submissions from a wide range of stakeholders. The quality of the evidence based on comprehensive research findings and the knowledge and insights provided were of tremendous assistance in preparing this report. The submissions are contained at Appendix 1 as valuable reference material.

The Committee met with key stakeholders including relevant unions; school management bodies; key statutory and representative bodies; other relevant organisations and, most importantly, we heard the voices of young people themselves. Mr Shane O'Connor and Mr Liam Carew, 2023 Young Scientists of the Year and Worldskills Award Winners Mr Jamie Bermingham, Plumbing Apprentice and Mr Martin Scattergood, Sheet Metal Work Apprentice, assisted the Committee greatly by sharing their perspectives and experiences.

The Joint Committee also met with a panel of distinguished academic experts who provided excellent guidance and support to the Committee. I would like to thank Dr Margaret Leahy, Head of the School of STEM Education, Innovation & Global Studies and Professor Hamsa Venkat, Professor of STEM Education for Primary and

Early Childhood Education, both from the Institute of Education, Dublin City University (DCU), who steered the Committee in the right direction at the outset.

Senior Officials from the Departments of Education and Further and Higher Education, Research, Innovation and Science, came before the Committee with key statutory bodies and provided very beneficial briefings on their plans for STEM.

Arising from this, the Committee examined the evidence heard and the submissions received and drew up this Report containing concrete and feasible recommendations. The Committee genuinely believes these can be implemented without delay and can provide a clear road map for the future of STEM in Irish Education.

The Irish education system should give students the confidence to enter the wider world with the life skills to progress to whatever path in life they choose to take. Ensuring students have full access to STEM subjects from Pre School and onwards will give them unrivalled opportunities as they face the future.

Once again here I reiterate that young people are our future. The future is uncharted territory given the enormous challenges we all face in terms of the Environment and Climate Change; Geo Political Threats; Digital Technology including Artificial Intelligence (AI) and so on. However, those with a willingness to embrace STEM as an integral part of their learning journey will have enormous opportunities to make meaningful contributions to our country and on the international stage too.

All students must be given equal access to these opportunities. Diversity and difference should be respected and, indeed, celebrated in Irish Education. All barriers must be broken down and all students must be given the resources they need to engage in STEM.

The Committee is committed to ensuring these recommendations are implemented as expeditiously as possible.

On 12 July 2023, the report was agreed to be published by the Committee.

The Joint Committee also requests that the issues raised in this report be the subject of a debate in both Houses of the Oireachtas.

Paul Kehoe T.D.,

Cathaoirleach,

Joint Committee on Education, Further and Higher Education, Research, Innovation and Science.

12 July 2023

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EXECUTIVE SUMMARY

There was a consensus among all the stakeholders that early childhood is the ideal time to introduce STEM concepts as young children are naturally curious and inquisitive. Introducing STEM at this age does require a structured pedagogical approach. To this end, Early Childhood Education should be the responsibility of the Minister for Education.

It was also universally agreed that teachers must have knowledge and enthusiasm for STEM subjects if they are to teach them with confidence. Therefore, a Mandatory Module on integrated STEM Education should be provided in all Initial Teacher Education (ITE) courses, and to all Early Years Education, Primary Teachers as part of their Continuous Professional Development (CPD).

The National Children's Science Centre, in gestation for many years, should be opened as a matter of urgent national priority. It will send out a message that Ireland is very serious about science education for Primary and Post Primary students.

The Department of Education should publish revised specifications for Physics, Chemistry and Biology at Senior Cycle by the end of 2023. A key priority should be that the revised syllabus for each subject is far more detailed with comprehensive instructions for teachers.

Recruitment and Retention of qualified teachers emerged throughout the examination as a matter of critical concern. An *Expert Working Group on Teacher Supply for STEM Subjects and Computer Science* should be established by the Department of Education.

Evidence shows that talented and gifted students are not supported enough. The Department of Education should develop a *National Programme for High Performing Students*[1] in Primary in and Post Primary Schools to enable them to reach their full potential.

[1] High Performing Students should be identified primarily on the results of the Drumcondra Standardised Tests in English and Mathematics from Second Class and onward.

An *Expert Working Group on Pathways from Further Education to Higher Education* should be established to ensure that all citizens are given the opportunity to progress in their lives and fulfil their true potential.

Apprenticeships are now seen as gateways to exciting and fulfilling careers. Funding must be provided to the Technological Universities (TU)s to ensure there is sufficient physical capacity and lecturer capability to deliver on the increased numbers of Craft and New Generation Apprentices.

In a spirit of genuine partnership and joined up thinking an *Expert Working Group on STEM Subjects and Increased Female Participation* should be established by the Department of Education.

Digital learning has become fundamentally important in all our lives. The Department of Education should publish an Implementation Plan so that the excellent Digital Strategy for Schools to 2027 becomes a reality.

The other recommendations in the report are also very important in terms of driving this agenda forward and really making a difference in creating a Whole STEM Culture throughout the Irish education system.

TEN KEY RECOMMENDATIONS

Below are the Ten Key Report Recommendations, listed by order in which they appear in the main body of the Report. They are of equal value.

1. Responsibility for all Early Years Education should be transferred from the Minister for Children, Equality, Disability, Integration and Youth to the Minister for Education to ensure, *inter alia,* that STEM education is an integral part of the Early Childhood Care and Education programme (ECCE).

2. A Mandatory Module on integrated STEM Education should be provided in all Initial Teacher Education (ITE) courses, and to all Early Years Education, Primary Teachers as part of their Continuous Professional Development (CPD) These models should be geared towards teaching and learning that supports inquiry, experimentation and higher-order thinking and skills in the STEM areas.

3. The National Children's Science Centre should receive the full support of Government with a view to an early launch in Q4 2023. Once opened, it is recommended:

- The Centre receives Ring Fenced Funding on a Multi Annual Basis from the Department of Education to ensure it is adequately resourced to fulfil its mandate.
- The Centre liaises with the Department of Education Inspectorate so that it can play a central role in supporting STEM in the Primary and Post Primary School Curriculum.
- The Department of Education issues a Circular to all Primary and Post Primary Principals with a view to ensuring students visit the Centre as part of the STEM Curriculum.

4. The Department of Education should publish revised specifications for Physics, Chemistry and Biology at Senior Cycle by the end of 2023. A key priority should be that the revised syllabus for each subject is far more detailed with comprehensive instructions for teachers. The Committee recommends that the National Council for Curriculum and Assessment (NCCA) reviews the proposed design of the new specifications to ensure teachers are properly supported and students are taught to the highest professional standards.

5. An *Expert Working Group on Teacher Supply for STEM Subjects and Computer Science* should be established by the Department of Education in Quarter 4, 2023. The Group should be chaired by an external expert and comprise teachers, the National Council for Curriculum and Assessment (NCCA), Relevant Teacher Training Institutions, Subject Matter Experts and senior officials from the Departments of Education and Further and Higher Education, Research, Innovation and Science.

6. The Department of Education should develop a *National Programme for High Performing Students*[2] in Primary and Post Primary Schools to enable them to reach their full potential. The Department should liaise with the Centre for Talented Youth (CTYI) in Ireland at Dublin City University (DCU) in this regard with a view to agreeing on a Service Level Agreement (SLA) that would include, *inter alia*, Training for Teachers in Programme Delivery. The Programme should be rolled out nationwide so that all relevant students have equal access to it.

7. An *Expert Working Group on Pathways from Further Education to Higher Education* should be established by the Minister for Further and Higher Education, Research, Innovation and Science. The Group should be chaired by an External Expert and be comprised of Senior Department and Higher Education Authority (HEA) Officials, the Irish Universities Association (IUA), the Union of Students in Ireland (USI), the Technological Higher Education Association (THEA), SOLAS, Industry Representatives and Staff Unions. The Group should identify current opportunities and barriers to progression from Further to Higher Education and establish how to develop links between both sectors that allow for more seamless progression.

[2] High Performing Students in Primary Schools should be identified on the results of the Drumcondra Standardised Tests in English and Mathematics from Second Class and onward.

8. The Higher Education Authority (HEA) should provide ring fenced funding to the Technological Universities (TU)s, as necessary, to ensure there is sufficient physical capacity and lecturer capability to deliver on the increased numbers of Craft and New Generation Apprentices. To this end:

- The Department of Further and Higher Education, Research, Innovation and Science Emergency should provide Short Term Funding to bridge the gap.
- From 2023, the Department should provide Multi Annual Funding through a new Apprenticeship Fund.
- The Higher Education Authority (HEA) should commence a Review of the Craft and New Generation Apprenticeship Building Requirements by Q3, 2022, with the aim of delivering the buildings required to ensure Apprentices are educated to the highest international standards within a 3-year period.

9. The Department of Further and Higher Education, Research, Innovation and Science Education should establish a Consolidated System for the compilation of disaggregate Data Collation and Measurement on the researchers to include gender, disability, ethnic minority and economic status. The data should also record the nature of individual research being undertaken and the proposed outcomes. This data should be used to inform the development of educational policy on an ongoing basis.

10. The Department of Education should publish an Action Plan to implement *the Digital Strategy for Schools to 2027* by Q4 2023.

INTRODUCTION

Globally, humanity faces rapid technological advancements and societal changes, along with uncertainty over the future of work, the economy, and society. STEM will play a critical role in all our futures and STEM education is vital in preparing students for the future and providing individuals with the skills and knowledge necessary to succeed in a wide range of careers and fields in the rapidly changing world. STEM jobs are more in demand every day and expected to grow exponentially over the next few years.

In its submission, the National Association of Principals and Deputy Principals (NAPD) referred to the United Nations Educational, Scientific and Cultural Organisation, UNESCO Paper published in 2019 *"Exploring STEM Competencies for the 21st Century*". The paper contends that the core feature of STEM is the use of science, technical and engineering knowledge to solve daily or societal problems. It opines that this makes the learning of science, technology, engineering and mathematics more meaningful and contextual for students.

The NAPD also asserts that '*Humanities and STEM are indeed complementary and the skills learned are transferable to every other area of the students life. While problem solving, critical thinking and collaboration are critical for success, the most important attribute that will support the future development of STEM in Irish education is attitude*'. This assertion or variations of it is repeated in several other submissions.

In oral evidence, on 9 March 2023, Mr Paul Crone, Director, NAPD made insightful comments on the State examinations at post primary level- '*The reformed junior cycle prioritises skill development and the STEM skills that I outlined earlier are central to all aspects of the junior cycle. This prioritisation of skill development over knowledge retention is lost once the students enter senior cycle. The continued significance of the terminal exam and the selection procedures for higher education continue to impact on the curriculum at senior cycle.*

Senior cycle is currently out of line with the junior cycle and the primary curriculum. It is a matter of urgency that we expedite meaningful senior cycle reform to bring

coherence to our system and give students the freedom to explore the STEM skills of problem solving, critical thinking and collaborative learning. In addition, to further break down the barriers to participation in higher education, the development of pathways for every student must be pursued. Removing the cliff edge of the leaving certificate, creating adequate pathways for all and affording students the opportunities to pursue their passion are key. We must give students the opportunity to explore and pursue inquiry-based learning or phenomenon-based learning and give them time to discuss, reflect and grow in confidence and competence.'

In its submission, the Higher Education Colleges Association (HECA) submission refers to National and international competency frameworks that broadly agree on the importance of 21st century skills, which are transferable knowledge and skills that learners need for STEM proficiency.

It reported that, in Ireland, STEM education is a key focus in various educational policies such as the Action Plan for Education, National Skills Strategy, Arts in Education Charter, National Strategy: Literacy and Numeracy for Learning and Life, Digital Strategy for Schools to 2027, and the STEM Education Policy Statement 2017-2026. The STEM Education Policy Statement identifies actions to be taken in initial teacher education (ITE), including improving the quality of ITE, developing guidelines for STEM education in school placement, and fostering partnerships between ITE, STEM research, and industry.

In oral evidence, on 25 April 2023, Ms Evelyn O'Connor, Principal Officer, Department of Education reported that '*The building and sustaining of a vibrant STEM and digital education ecosystem for all learners will require ongoing innovation in STEM and digital education underpinned by evidence.*
There are many areas where work is ongoing in order to further enhance STEM and digital learning within our schools. This work includes the development of a strategic framework for lifelong guidance, a comprehensive programme of work to support teacher supply with a number of measures being progressed, the development and implementation of recommendations in relation to gender balance in STEM and primary and senior cycle redevelopment. The Department will continue its work with

colleagues in other Departments and with the wider education stakeholders, in order to provide a high-quality STEM education experience for all our learners that creates a positive disposition towards STEM and digital learning, and enables them to participate, influence and succeed in a changing world.'

In oral evidence, on 25 April, Ms. Karen Murtagh, Assistant Principal Officer, Department of Education, made the fundamentally important point about the future of STEM '*In all of this, we cannot lose sight of this not just being about the world of work and pushing kids into STEM jobs. The skills they learn within STEM subjects in school are vital for everyday life such as problem solving and critical thinking. When the committee is considering this, it may consider STEM skills are needed for all learners, no matter whether they progress to the world of work within a STEM career.'*

CHAPTER 1 – EARLY YEARS AND PRIMARY EDUCATION

EARLY CHILDHOOD EDUCATION AND CARE (ECEC)

In their submission, Professor Hamsa Venkat & Dr Margaret Leahy, Head of the School of STEM Education, Innovation & Global Studies and Professor Hamsa Venkat, Professor of STEM Education for Primary and Early Childhood Education, Institute of Education, Dublin City University (DCU) outlined how it is well recognised that important foundations for future learning, achievement and wellbeing are developed in the early years.

The submission further expanded on this by explaining that this is similarly the case for STEM Education. The submission pointed out that young children are naturally inquisitive, creative, and collaborative; these are innate dispositions which lend themselves well to STEM education.

Although an emergent area of focus in Early Childhood Education and Care (ECEC), STEM research and policy published in the last five years recommends the introduction of STEM education at an early age. This is perceived as important for the development of the foundations of skills, knowledge, beliefs, confidence and self-efficacy in STEM. It is also important as STEM achievement gaps are known to begin in the early years and will persist if unaddressed.

The submission evidentially noted that the empirical research base indicates that STEM provision in ECEC is linked with significantly higher enthusiasm and motivation for science in later life and is predictive of later academic achievement in mathematics knowledge and skills. It explains that the introduction of engineering provides a cross-disciplinary foundation that contextualises young children's mathematics, science, and technology learning, and supports meta-cognition.

Despite this, the submission noted that evidence indicates that STEM in ECEC is often of poor quality. Educators report that their initial education does not prepare them to support STEM in ECEC.

The submission refers to negative beliefs about STEM and poor self-efficacy that impacts on STEM practices in ECEC settings. Discipline content knowledge is also weak as that STEM is not a required subject in ECEC initial education.
The submission proposes adapting a play-based approach to STEM Education as this is seen as particularly beneficial in the early years. It also advises that proficiency in the fundamentals of each discipline is the first step toward competent integrated STEM education in ECEC.

In oral evidence, on 18 April 2023, Dr Sarah McCormack, Professor in Environmental Engineering, Trinity College Dublin, outlined the trajectory that often follows STEM '*Sometimes there is an idea, even going back to primary school, that certain students are not good at maths or science and they might pick biology because they think physics is too difficult. These are misconceptions some people hold but they might not know enough about physics to say whether it is too difficult. Breaking down those biases regarding the subjects is important. Likewise, in the case of computer science, the mention of algorithms is enough to turn some students off the subject. Explaining to them what an algorithm is and how they are used in everything we do today is important, and it is about getting in early to explain what these subjects are. We often see the unconscious bias stuff whereby people are waiting on the firefighter to come in. They are expecting men and it turns out to be women, and the little kids are so surprised because they have never seen a woman firefighter before. With these types of things, it is very important that we try to get in as early as possible so they understand the opportunity is there for everyone.'*

TEACHER TRAINING

In its submission, The National Parents Council (NPC) referred to an NPC National Parents Council Primary Survey on STEM Education in Primary and Post Primary Education. The survey found that the majority (79%) of parents reported that their child is interested in and excited about learning about STEM subjects in school. However, the most common response to what nurtures this excitement, were the child's own interest in and enjoyment of STEM subjects (68%). Only 21% of parents said that their child's teacher seems passionate about STEM subjects.

15% of parents felt that their child's teachers "*access to the materials and upskilling needed to teach STEM subjects*" supported their interest. Parents identified things like opportunities for "*designing & making things at school*" (66%) and "*being supported and encouraged to imagine, question, be curious and explore objects and ideas*" (53%) as things that would further support their child's STEM learning. 51% of parents said having a teacher who seems passionate about teaching STEM would support their child's engagement. 49% of parents felt that their child's teacher having access to the materials and upskilling needed to teach STEM would support their child's STEM education.

In its submission, the Irish National Teachers Organisation (INTO) stated that '*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. It recommended 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.'*

In its submission, the Engineering and Technology Teachers Association (ETTA) opined that '*there is a need for an educational campaign with supporting CPD for primary teachers to provide in-depth and meaningful experience and resources to aid all the primary teachers of all aspects of STEM subjects, with specific emphasis on supporting the transition to post primary. It would be important to engage parents through a national information campaign on STEM subjects and the progression from primary to post primary and tertiary, while informing them of careers available and paths after the completion of tertiary education. The STEM area is ever changing and generally, without specific knowledge about an area of STEM, parents fall into using outdated, stereotypical outlooks on these areas, undoubtedly influencing their kids.'*

In oral evidence, on 21 March 2023, Mr Barry Convey, ETTA, made a compelling point about the prevailing culture regarding STEM capabilities '*I do think there is an issue about confidence among primary-school teachers but also about students' perceptions. When they get into second level, they already have this*

preconceived notion that STEM is difficult. We have to really look at where that is coming from. If I tell a taxi driver that I am a maths teacher, the response is "Oh God, I hate maths, I was useless at maths". It is like a national pastime. We are delighted celebrating how bad we were at maths. Nobody would ever say "I cannot read, I find it difficult to read". That is a huge shift in psychology that we need to make in this country. Maybe it is something we need to look at from primary school. We need to move away particularly from treating maths as a subject of being right and wrong, black and white. We need to promote the idea of students challenging themselves, trying and doing something instead of giving up just because they do not feel they can get all the way through to the final answer.'

INTEGRATION AND RESOURCING OF STEM

In its submission, the Irish Primary Principals Network (IPPN) made a profound observation, that the biggest challenge to the promotion of STEM is the simplest one. If children – both girls and boys - are exposed to interesting, well thought-out, well-planned STEM lessons that build on their previous work, then they will be more interested in taking these subjects at second level. Research shows that, where interest is not developed by the end of primary, children do not take these subjects later.

It further stated that there is widespread agreement in primary education that, while STEM subjects are valuable, there should not be undue emphasis on them at the expense of other aspects of education, especially the Arts. It refers to other developed countries who have adapted STEM to include the arts, known as 'STEAM'. It opined that there is an opportunity for the Department of Education and the NCCA to integrate the curricula to cover all of STEAM.

Referring to the new Primary Curriculum, it contended that there is an opportunity to further promote and develop the 'softer skills' – particularly communication and interpersonal skills - and pupils' creativity within the curriculum, alongside enhanced STEM education. It further contended that these life skills are crucial to any organisation, including those in the technology industry.

The INTO Submission made an important point that '*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.'*

It opined that there is a need for an educational campaign with supporting Continuous Professional Development (CPD) for primary teachers to provide in-depth and meaningful experience and resources to aid all the primary teachers of all aspects of STEM subjects, with specific emphasis on supporting the transition to post primary. It referred to how important it is to engage parents through a national information campaign on STEM subjects and the progression from primary to post primary and tertiary, while informing them of careers available and paths after the completion of tertiary education.

In oral evidence, on 7 March 2023, Ms Máirín Ní Chéileachair, Assistant General Secretary, INTO, made an important observation '*We need to look at it on a much wider scale with engagement from a very young age, from early childhood at primary school. A number of years ago the Department of Education put in place some protocols with technology companies engaging with schools but it was at a very basic level. We need to look at that and to encourage all students to see women, be they snooker players or soccer players, in their jobs and we would not normally think about how STEM comes into jobs. I was privileged to engage in an NCCA consultation with children on STEM before Christmas and their perceptions were fascinating. They were very broad-minded in their concept of STEM.'*

Regarding investment, Ms Ní Chéileachair commented – ''*We said earlier that we would be hard-pressed to find a science lab in a primary school. We need to look at how we design learning spaces. We spoke earlier about creative multipurpose spaces, which are sadly lacking in our schools at primary level. We are very good at providing classroom accommodation and perhaps, if one is lucky, God save us, a halla. Aside from that, there are no flexible learning areas in our schools which can be used for creative learning, and for things that require movement and*

collaboration. Classrooms, to a certain extent, can be used for these purposes but there needs to be a look at creative indoor and outdoor spaces. I realise that I am repeating myself but it is very important that these flexible spaces are made available at a very basic level, even somewhere where infants and early learners can go to play and engage with sand, water and all of those things which develop early STEM skills, such as exploration, manipulation of materials, playing with concrete materials, using their hands and working together in teams. Sometimes traditional classroom spaces do not allow for that so we need to look at the development of creative spaces and outdoor learning space.'

In its submission, the Institute of Physics (IOP) noted that a curriculum alone does not deliver change in the education system. Rather, it does so in conjunction with the empowerment of teachers and schools. It contends that without support and empowerment, most teachers opt for the elements of STEM that they are most confident in their own abilities to teach. With the common misconceptions about physics, it is the IOP belief that a lack of teacher support has/would result in physics being one of the more neglected STEM subjects.

In oral evidence, on 25 April 2023, Ms Arlene Forster, CEO, National Council for Curriculum and Assessment (NCCA) reported that '*Looking then at the future of STEM in Irish education, we have some great opportunities ahead of us. I mentioned the new primary mathematics curriculum in the opening statement. One of the important messages underpinning the overall philosophy of that curriculum is mathematics is for all and everybody can succeed in mathematics. That is a very important message. As to how that transacts in terms of teaching and learning, there is a strong emphasis on children being active in their mathematical learning, talking about their mathematical learning and talking aloud about how they are thinking and collaborating with each other. We know from literature that when you use that type of pedagogy, specifically that inquiry-based approach, in maths or in any aspect of science, it motivates and captures the interest of children. I hope an emphasis on that type of approach to STEM education will help us to motivate and encourage children and to ultimately work towards a more balanced approach when it comes to the gender take-up of STEM subjects as young people move into post-primary education.'*

In its submission, Technological University Dublin (TUD) cited multiple research studies that demonstrated children as young as age six endorse stereotypes that girls are less interested than boys in computer science and engineering (Master, Meltzoff & Cheryan, 2021) and believe that boys are better than girls in some STEM subjects such as programming (Master, Cheryan, Moscatelli & Meltzoff, 2017).

TUD proposed that the '*primary curriculum should be amended to foster an interest in STEM, primarily through the use of practical examples in the classroom. This should aim to foster the child's capacity to understand and engage fully with the world around them, with an emphasis on problem based learning using basic STEM principles. A simple toolbox of STEM activities could be deployed across primary schools. Consultation with stakeholders in the design of this would be important.'*

It also proposed that consideration should be given to gearing school tours towards fun STEM-related sites such as hi-tech manufacturing plants and data centres, Universities, and museums. It also made the insightful point that engagement with a gender-balanced selection of employees can serve as early role models for all children.

Other submissions, including personal testimonies from Worldskills Award winners and the 2023 Young Scientists of the Year, point towards the value of having STEM related Competitions and extra curricular activities to engender a sustained interest in these subjects.

Dr Áine Hyland, in her submission and in oral evidence given on 21 March 2023, outlined plans for a National Children's Science Centre, due to open shortly at the National Concert Hall Building, Earlsfort Terrace, Dublin 2. The centre will house three floors of immersive, interactive exhibits and a state-of the art Digital Planetarium with further capacity to host travelling exhibitions.

Dr Hyland made the pertinent point that this vital initiative aligns with the government's *STEM Education Policy Statement 2017-2026* which emphasises the need to nurture curiosity, inquiry, problem-solving, ethical behaviour, confidence and persistence, along with the excitement of collaborative innovation*.'*

It will also contribute to the implementation of the United Nations Sustainable Development Goals and will be a resource for teachers in the interpretation of and expansion of the Department of Education's STEM curriculum.

In its submission, the Irish National Teachers Organisation (INTO) recommended the full restoration of middle-management posts in primary schools to 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. The Teachers Union of Ireland (TUI) made a similar recommendation for Post Primary Schools.

The INTO submission also highlighted that outdoor learning provides children with an opportunity to experience the interdisciplinary nature of the real world through interactions with each other and the planet. It opined that 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). It recommended that sufficient investment must be provided to develop outdoor spaces in schools to facilitate the interdisciplinary nature of STEM.

In its submission, Airfield Estate proposed that STEM in Irish Education must incorporate food education, and that "hands-on" experiences should be built into this. It notes that this method of teaching has a huge positive effect on learning, and on igniting a passion for STEM subjects among students.

RECOMMENDATIONS: PRIMARY EDUCATION

1. Responsibility for all Early Years Education should be transferred from the Minister for Children, Equality, Disability, Integration and Youth to the Minister for Education to ensure, *inter alia,* that STEM education is an integral part of the Early Childhood Care and Education programme (ECCE).

2. ECCE Initial Teacher Education (ITE) must contain STEM modules to enable STEM Education to begin in early childhood, as supported by the Early Childhood Curriculum Framework, AISTEAR.

3. The Primary School curriculum must include:
    - A stipulated weekly time allocation for science as this has been under pressure in recent years.
    - A stipulated time per term for work involving integrated STEM projects across other subjects and across all primary grades.
    - Both practising and student teachers must be provided with exemplar support materials to build confidence and facilitate teaching Science in addition to a programme of initial and in-service teacher education focused on supporting integrated STEM.

4. A Mandatory Module on Integrated STEM Education should be provided in all Initial Teacher Education (ITE) courses, and to all Early Years Education, Primary Teachers as part of their Continuous Professional Development (CPD) These models should be geared towards teaching and learning that supports inquiry, experimentation and higher-order thinking and skills in the STEM areas.

5. Additional targeted teacher allocation should be given to schools so that small schools can provide STEM subjects with small classes and thereby equitably maintain student choice and equality of opportunity. This additional

teacher allocation could be provided by way of curricular concession. Curricular concession should also be provided where schools wish to provide new subjects such as Computer Science.

6. The Department of Education should restore middle management positions removed from schools and undertake an assessment of School Leadership posts at Primary level. This would afford them the opportunity to delegate STEM-related preparation for teaching and learning to an in-school management team member.

7. All new school builds and school upgrade programmes should include a STEM resource room(s) that can be used for project work (and could double up for use in other subjects) to support inquiry and experimentation.

8. Outdoor learning provides children with an opportunity to experience the value of exploring the natural world and their environment. Sufficient investment must be provided to develop outdoor spaces in schools, particularly those currently without access to such spaces, to facilitate the interdisciplinary nature of STEM.

9. The National Children's Science Centre should receive the full support of Government with a view to an early launch in Q4 2023. Once opened, it is recommended:

- The Centre receives Ring Fenced Funding on a Multi Annual Basis from the Department of Education to ensure it is adequately resourced to fulfil its mandate.
- The Centre liaises with the Department of Education Inspectorate so that it can play a central role in supporting STEM in the Primary and Post Primary School Curriculum.

- The Department of Education issues a Circular to all Primary and Post Primary Principals with a view to ensuring students visit the Centre as part of the STEM Curriculum.

CHAPTER 2 POST-PRIMARY EDUCATION

TEACHER RECRUITMENT AND RETENTION ISSUES

In its submission, The Irish Maths Teachers Association (IMTA) expressed concern about the serious shortage of qualified mathematics teachers in the state at present, despite initiatives such as the introduction of the Professional Diploma in Mathematics for Teaching (PDMT). It proposes offering financial incentives to encourage qualified graduates to become maths teachers. It also makes the point that teacher training places should be ringfenced for STEM teachers.

It further proposed that '*Consideration should be given to the length of time taken from entering college to qualifying as a teacher, especially in the situation in which student teachers are not paid. The state should foot the bill for prospective STEM teachers or offer them a full reimbursement of their fees after successfully working as a teacher in an Irish school after 5 years (or similar). We need to offer more supports to newly qualified teachers too and pay them a full 22-hour salary but increase their teaching load gradually over a number of years. NQTs should be mentored for a number of hours per week and encouraged to visit other schools and settings during time that they are not scheduled to teach. We need to nurture our NQTs; not scare them off.'*

Finally, it recommended that the Teaching Council (TC) review the requirements it specifies for accreditation of teachers. It contends that the present ones impose barriers that exclude good candidates.

In its submission, the Institute of Physics (IOP), identified, *inter alia*, how high-quality teaching from a *subject specialist* is one of the single most important factors in pupil experience, attainment and whether or not they pursue the subject post-16.

It noted that '*within the Irish system there are no physics-only teachers with a teacher often delivering a small number of different subjects. This reduces the chances of a teacher having a physics specialism and means their time for CPD has to be spread across all their subjects. Equally, the high demand for physics skills reduces the future teacher pool further. They will likely have more attractive*

alternative offers unless they have a vocation to teach. Few physics undergraduate, postgraduate and PhD students intend to go into teaching, especially considering the financial incentives to work in other sectors; research in England highlights the role that financial incentives can play in teacher supply, including in shortage subjects. Thus, we believe the Committee needs to examine how physics teaching can be made a more attractive option and how non-specialists can receive full subject specific training before commencing teaching.'

In its submission, the Teachers Union of Ireland (TUI) referred to a widespread recognition of a teacher supply crisis. It noted that studies by management bodies, teacher unions and State agencies all give evidence of this. For example, a TUI survey of school leaders in October 2022 found that 91% of schools had experienced difficulties in hiring teachers in the previous six months. Problems were reported in almost all subjects but the biggest difficulties were reported in the areas of Maths, Irish, Home Economics, Chemistry and French.

In oral evidence, on 28 February 2023, Mr. John Curtis, General Secretary, Joint Managerial Body (JMB) commented that '*The reasons underpinning the severe shortage of teachers who are qualified and registered to teach STEM subjects requires investigation because it provides important indicators of the policy-level direction required for us to emerge as a high-capacity education and, ultimately, workforce contributor to the economy. Indicators that should be addressed include: the high cost of qualifying as a secondary school teacher and the risk of exclusion of particular social groups impacting on teaching workforce diversity; the duration of the teacher qualification and recognition processes and the attractiveness to graduates of career pathways other than teaching; the need to remain in constant touch with accelerating STEM-field developments; and the lack of supports in social and ethical education and their pedagogies as they relate to STEM areas of learning and life. The good news is that our educators are not short of motivation. What is needed is a coherent framework under which their innate love of their subject areas, their indisputable agency and innovative capacities and their student-centred approaches to their vocation can offer a perfectly aligned set of conditions in which STEM education can be invigorated as a national priority'.*

TEACHER TRAINING AND UPSKILLING

The TUI submission referred to the difficulties in initial teacher education (ITE) post-primary, specifically students having to spend up to six years studying to be a teacher. It noted that there is a substantial financial cost to such study but also a very large opportunity cost to the student of not having an income for six years. It noted that '*TUI has long made clear that the duration, and cost, of initial teacher education discourages students from choosing to enter teaching careers.'*

In oral evidence, on 7 March, Mr David Duffy, Research Officer, Teachers Union of Ireland (TUI) expanded on this '*Regarding role models, we could certainly benefit from more diversity in the teaching profession. A number of colleagues in higher education institutions along the west coast have done a lot of work on this. The big issue probably relates to the opportunity and financial cost after a longer period of initial teacher education. In many cases it can take six years. Someone contemplating spending six years in college studying to be a teacher needs to have quite a bit of social capital and financial capital to begin with. That would help in getting a more diverse teaching profession.'*

In oral evidence, on 7 March, Professor Lisa Looney, Vice President for Academic Affairs and Registrar, DCU, expanded on teacher upskilling *'We will never stop needing continuing professional development for teachers at a very high level. The closer we get to the teacher in the classroom, the more impactful the change will be. We must be able to model good practice with our teachers, show them what it looks like and bring industry and higher and third level into the classroom so teachers can see what it is all about. I am concerned we are not seeing that at post-primary level. It is a huge area we may need to look at collectively. We must examine upskilling programmes for teachers. We talk about teacher supply and the lack of teachers in areas. There are a cohort of teachers who 30 JEFHERIS are excellent at their jobs and, perhaps, with another 60 credits of upskilling, could teach maths, biology or engineering and could transfer. We need to examine more technology and using shared teachers across the system. If we do not get the teaching right, all the other things do not*

fall into place. We must focus on that quality at this point and investing in that, at primary, post-primary and initial teacher education level.'

In its submission, the Irish Second Level Students Union (ISSU) recommended that STEM teachers are trained and upskilled so that they have the relevant skill set required for the integration of the Digital Strategy.

In oral evidence, on 28th February 2023, Mr. Martin Gormley, Director of Schools, Donegal Education and Training Board, representing Education and Training Boards Ireland (ETBI), gave the following insights into training and upskilling '*Training and support in STEM for school leadership should become part of a professional development model to ensure that all leaders have the relevant knowledge to drive the STEM agenda in schools. If leadership is not coming from the top and from management, it may not happen in a school. Oide, the new body that will encompass the professional development service for teachers, junior cycle for teachers, the centre for school leadership and the national induction programme for teachers, will also provide an opportunity. The coincidence of this integration, alongside the redevelopment and implementation of a new curriculum, a junior cycle programme and a revised senior cycle, provides a significant opportunity to harness the strength and experience of these existing services to embed and fully realise STEM.'*

Mr Gormley also outlined in his evidence current upskilling models that could be used '*The University of Limerick has a qualification in project maths for out-of-field teachers. This has significantly reduced the number of teachers in the classroom who are not qualified in maths. Perhaps a similar model for other STEM subjects might be worth considering. We have had a problem with junior cycle coding and computer science at leaving certificate level but we have been working with Atlantic Technological University on upskilling teachers to be able to deliver on it. A similar model to that for maths replicated for other subjects would be both useful and helpful.'*

In its submission, the Higher Education Authority (HEA) stated that there needs to be a focus on providing targeted training in each school, relative to the size of the school, to promote informed inhouse leadership in STEM education.

In oral evidence, on 28th March 2023, Ms Claire McGee, Irish Business and economic Federation (IBEC), emphasised the importance of teacher training, by stating '*many European and international studies have highlighted the importance of strengthening teacher competencies in STEM areas and industry can play an important role in facilitating teacher training through placement opportunities for initial teacher education and co-teaching by industry staff, as well as opportunities for career guidance and service teachers to gain an understanding of the needs of the evolving industries.'*

In oral evidence, on 18 April 2023, Dr Cornelia Connolly, Associate Professor, School of Education, College of Arts, Social Sciences & Celtic Studies, University of Galway noted that '*There is a shortage of teachers in computer science education globally. We have to think creatively around how to upskill teachers. There is a very successful professional diploma for mathematics teaching, which is ongoing over recent years through University of Limerick and University of Galway. Offering a similar programme to those teachers in our system to upskill and become qualified computer science teachers would be an easy win. We need, however, to incentivise people into computer science education and encourage more into the education space. The internship programmes for student teachers is an obvious choice, as is expanding and showing the range of skills possible within computer science education. We must also be conscious of the learning pathway. It is very difficult for students to select computer science or a STEM teacher education programme coming from their leaving certificate if they have not studied the subject in secondary school.'*

In its submission, An Chomhairle um Oideachais Gaeltachta agus Gaelscolaíochta (COGG) outlined proposals to ensure that Gaeltacht and Irish-medium schools are on an equal footing with the other schools in the system both now and in the future for STEM provision in Primary and Post Primary Schools. To this end, it was noted that the availability of qualified STEM teachers with fluent Irish will be crucially important.

In oral evidence, on 25 April 2023, Mr. Diarmaid Mooney, Acting Director, Curriculum and Assessment, National Council for Curriculum and assessment (NCCA), reported that '*the NCCA is looking at the potential of virtual learning environments. It was built on a request that came from the Minister. Through our own research we also picked up on the physics in the Gaeltacht initiative. We are trying to build on that now and looking at what is possible. There was a shortage of physics teachers in Gaeltacht schools. This was an online initiative that was developed so that physics could be delivered in one school but other schools may join in at that point in time. We are engaging in a piece of research this year to examine the potential of virtual learning environments, VLEs, in particular in terms of subject spaces, the likes of transition year and non-attendees at school. Where there may be a shortage, we are considering the potential of the online environment.'*

INTEGRATION OF STEM INCLUDING TRANSITION YEAR (TY)

The NAPD submission makes the point that '*the development of STEM skills cannot be the sole responsibility of the STEM subject teachers.'* It and other submissions also refer to curriculum overload and the inherent dangers in this that essential learning is prioritised and skill development is minimised.

The NAPD states that curriculum overload can be an issue for many students at Senior Cycle, particularly when they are studying subjects they are not interested in and may feel they are not good at. It advised that reducing the curriculum content for students has the added advantage of creating time. It would give time for reflection on the learning, for exploration, experimentation and for embedding the skills, many of which are also the STEM skills that students will have been developing since primary school.

Mr Paul Crone, NAPD, expanded on this *stating 'It is humanities, ethics, creativity and imagination. These, I suppose, are at the other side of STEM but they are not really. They integrate with each other and we cannot ignore one for the want of the other. People are successful in STEM subjects when they have a good basis in the humanities in that they exercise ethics, are creative and can use their imagination.*

We have to look at the holistic and well-rounded individual which is very important for our system.'

The Irish Science Teachers Association (ISTA) in its submission was emphatic that the current template of syllabus design should be replaced by a template which reflects international best practice. It recommended that '*A new syllabus template needs to be developed for all syllabi at Junior Cycle and Leaving Certificate level. This template must contain more detailed information about the depth of treatment of subjects including the linking of learning outcomes to teaching and learning activities and to assessment.'*

Dr Áine Hyland, stated that *'there is a mismatch in a way between current developments, such as the changes in the junior cycle and leaving certificate, and the examination and assessment, the State Examinations Commission and the NCCA, which has been pointed out before. There are also the very skeletal programmes, syllabi or specifications, as they are called, that are coming out now for the proposed new leaving certificate subjects. I do not think they give enough information to teachers and they do not go into sufficient depth. There is a real risk that standards will begin to fall.'*

In oral evidence, on 21 March 2023, Mr. Humphrey Jones, Irish Science Teachers Association (ISTA), once again expressed concerns about the syllabi '*The ISTA reiterates our commitment to supporting Ireland's STEM education plan, but we feel the current syllabus design model is a significant barrier to achieving its ambitions goals. We would like the committee to reiterate that several provisions must be made for the successful implementation of STEM subjects. A new syllabus template needs to be developed for all syllabi at junior cycle and leaving certificate level. A full range of documentation must be available before implementation of the syllabi. This must include teacher guidelines, practical coursework guidelines, sample examination papers and sample marking schemes. We recommend an external, independent evaluation be carried out on the junior cycle framework and the leaving certificate subjects that have already been implemented using the same template. This external evaluation should be carried out by personnel from outside Ireland and by experts in curriculum design.'*

In its submission, the Teachers Union of Ireland (TUI) asked '*that work resume as quickly as possible on the revised specifications for Physics, Chemistry and Biology which have been on pause since the Minister's Senior Cycle announcement of March 2022.'*

It also referred to the current uncertainty about the future of the combined Physics/Chemistry course at Senior Cycle. It sought confirmation from the Department of Education that this course will continue.

Several submissions referred to the need for curricular concessions to address teacher allocation and subject availability. Ms Moira Leydon, ASTI, stated 'A *dilemma which frequently faces schools is that they want to offer physics or chemistry, which are minority subjects anyway. To employ a physics or chemistry teacher, that teacher must also have a number of other subjects. There may not be sufficient demand to create a full-time, permanent post for that teacher. Decisions are made about what to prioritise. The unions have consistently responded that there should be, as Mr. Duffy said, curricular concessions in terms of teacher allocation and additional teachers allocated to the school to facilitate a wide curriculum. We have also made the point, which is a view the three teacher unions share, that we should be able to give teachers permanent jobs but they are shared between schools.'*

Several submissions raised the issue of gifted and talented students and the need to offer them additional supports so they can reach their full potential. The TUI Submission noted that '*In terms of international comparators the one notable negative for Ireland is our performance in terms of whether very high-achieving students in Ireland are being sufficiently challenged*.'

In oral evidence, on 28 February 2023, Mr. John Irwin, General Secretary, Association of Community and Comprehensive Schools (ACCS) stated' *That whole area of the performance of our highest performing students needs to be looked at it. In TIMSS, we have the same finding. Performance among the highest achieving students is somewhat poorer when compared to their peers in countries with similar overall performance. This is the key issue we need to address at the top level of our education system.'*

Professor Lisa Looney, DCU made the point '*we echo concerns expressed by others to this committee that the Programme for International Student Assessment, PISA, data show the higher performing cohort in Ireland is behind its peers internationally in mathematics.*'

The HEA Submission recommended that the revision of the Leaving Certificate/Senior Cycle curriculum and assessment needs to:

- ensure that all types of learners are catered for
- active learning and assessment approaches are integrated for STEM as well as cross curricular, - embed digital technologies in teaching, learning and assessment.

TUD submission proposed that TY programmes include engagement with local STEM industries and site visits to hi-tech manufacturing plants, data centres, Universities, museums, etc.

In oral evidence, on 7 March 2023, Ms Caitlin Faye Maniti, Irish Second Level Students Union (ISSU), expressed the view that '*ISSU welcomes the plan to implement the updated subject curricula mentioned in the senior cycle redevelopment publication in relation to the STEM subjects of biology, chemistry and physics. STEM needs to be more relevant to students. Many are just rote learning chemicals and experiments and not actually understanding what it is they are studying. Even laboratory subjects are taught to the exam. Some chemistry students may never perform a titration and can still get a H1 despite this. This is a massive oversight and senior cycle redevelopment presents an opportunity to rectify this and make STEM subjects engaging and relevant for students. The new leaving certificate climate action and sustainable development subject presents a rare opportunity for students to study a fast-evolving science relevant to their daily lives. The ISSU would like to take this opportunity to mention our recommendation for climate science to be included on the course which would further develop young people's passion for STEM.'*

In oral evidence, on 18 April 2023, Mr Liam Carew, 2023 Young Scientist of the Year, referring to the findings of his winning entry, noted that *'Along with the*

aforementioned areas, students were also surveyed on the extent to which they felt second level education equipped them with the skills to progress in life. In this question, transition year students rated the lowest. Given that STEM is a skills-heavy field, this indicates a significant opportunity for the transition year programme to be more reflective of the value of STEM in acquiring skills.'

In oral evidence, on 18 April 2023, Mr Shane O'Connor, 2023 Young Scientist of the Year, spoke about the value of competing in the Young Scientist of the Year '*People are applying skills they are learning. This was our second year competing in the competition and it was great to meet people who have similar interests to us and compete against them. The buzz of the whole competition was great. What we have learned since has been even more valuable.'*

INVESTMENT IN STEM RESOURCES

In her written submission, Ms. Norma Foley TD, Minister for Education, stated that the STEM Education Implementation Plan to 2026, developed by the Department of Education and the Department of Children, Equality, Disability, Integration and Youth, is to be published shortly.

The Minister referred to the consultation process, and that it identified various challenges to the provision of quality STEM education within schools. These included the gap in understanding of what integrated STEM looks like at primary level, the value put on STEM within the schools and external evaluations and the limited capacity in the provision of STEM subjects in post-primary schools. It also identified the need to provide additional support to educators in relation to their STEM content knowledge, particularly in relation to subjects where there is a shortage of staff, and the challenges in relation to ensuring that student teachers have opportunities to teach a STEM lesson while on placement.

Significantly, she explained that the Departments of Education and Further and Higher Education, Research, Innovation and Science '*will lead on the programme of work and will work with all STEM education stakeholders to address the challenges identified and realise the ambitious actions.'*

ROLE OF GUIDANCE COUNSELLORS

In its submission, the Expert Group on Future Skills Needs (EGFSN) opined that the expansion of the domestic pool of STEM professionals will rely to a significant extent on the more effective channelling of students towards programmes, and ultimately employment, in areas of identified skills needs and the addressing of barriers to STEM course and career choices. It contended that developing a skills identification and intelligence system, which can provide sufficiently granular information to effectively inform and maintain the relevance of education and training in such a fast-changing environment, will be central to this ambition.

It further advised 'the *development of a properly resourced and informed career guidance system and pool of guidance professionals, at secondary and tertiary level, which is more attuned to labour market trends, emerging and evolving career opportunities, and the variety of pathways into associated STEM careers. The targeting of parents, a key formative influence on career choices, will also be important.'*

In oral evidence, on 7th March 2023, Ms Moira Leydon, Assistant General Secretary, Association of Secondary Teachers in Ireland (ASTI), outlined the key role played by Guidance Counsellors and the resources required '*We have been here before to talk about guidance counselling in education. One fundamental dimension of equality in education at second level is making sure that, from the moment students enter second level education, they have that scaffolding, nurturing, pastoral care and guidance about and consequences of subject choice from the very start. At the moment, the allocation ratio means that a school of 500 pupils will get a person in the post for 18 hours. The typical teacher's post is for 22 hours a week. A school of 500 pupils is allowed a guidance counsellor for 18 hours, which is not a full post. That increases to 26 hours, which is a teacher and a quarter, for a school of 700. Our guidance system needs massive investment. We acknowledge the Department has put in place innovative, out-of-field training programmes for teachers in physics and chemistry, which is welcome. We need to keep up that because it is critical'.*
In oral evidence, on 28 March 2023, Ms Helen McMahon, Senior Strategy Policy Adviser, Enterprise Ireland (EI) introduced an interesting concept'……*once they*

move to the next level and are in secondary school, it gets much more into life mapping of lifelong career guidance and looking at career trajectory. Obviously, that goes further in their career in terms of career pathways. Again, it is about mapping out the age of the individual and how you interact with people through different stages of their growth. It is also then about mapping out the roles so that the career guidance professionals can have the knowledge to explain that to children and parents, who are, as everybody knows, hugely influential on their development at this stage.'

PROMOTION OF APPRENTICESHIPS

In its submission, the National Apprenticeship Office, recommended the development of additional targeted initiatives for primary and second level schools. It refers to the speed at which apprenticeships are being developed, and, how, within 1-2 years it is likely that up to 100 programmes will be available, with a large proportion of these in STEM areas. It states that schools, school principals, teachers and guidance counsellors play a key role in developing awareness of STEM education and apprenticeship opportunities. It proposes a coordinated programme of taster courses, competitions for teams and individuals, showcase events, briefings for staff as well as students.

The TUI Submission stated that apprenticeships need to be valued by Irish Society and other submissions and oral evidence given echo these sentiments.

Mr John Irwin stated that '*Apprenticeships are greatly undervalued in this State. When we look at how the media portray achievement, it is all about going to universities. They totally undervalue different styles of learning. The apprenticeship is such a valuable manner of learning. I am delighted that ETBs are becoming more engaged in the further education area and trying to rebuild what was basically torn down 20 years ago when people stepped away from vocational education. It was one of the great regrets in education that people stepped away from vocational education and stepped away from the value of the apprenticeship. Apprenticeships were just completely undervalued as a style of learning and what they promoted. I know some of my colleagues in the media will probably disagree with me on this, but*

some of that was media driven because what we highlighted as being important was the university or the IT and apprenticeships were very much second class'.
In oral evidence, on 28 March 2023, Mr. Michael Fitzgerald, Technical Training and Development Manager, ESB Networks, outlined their apprenticeship programme '*We make a great deal of effort to promote our apprenticeships. We do this through our apprentices themselves, who are advocates to their peers and act as a bridge to parents, teachers and schools. We have a very active campaign of school visits with 55 visits to different schools in 24 counties last year. Of those schools, 21 were DEIS schools. We also have a very significant programme of work with third level partners promoting science in DEIS schools, where people come in for a day and do technical skills. The plan would be that they would then choose STEM subjects in secondary school to give them an option of becoming an apprentice. We also do an ESB Science Blast programme, which reaches 20,000 school children at primary level every year. The plan there is to make science attractive and fun and to help people to break down whatever perceived barriers they may see around practical skills. It gives students the option to pick the right subjects so they can go on to be apprentices or in our case, to go on to be engineers from apprenticeships.'*

Mr. Jamie Bermingham made the salient point that '*A lot more could be done in transition year. I did my work experience in a garage, which was a big thing for me. It was kind of the dealbreaker. I knew after fourth year that this was what I was going to do. There definitely should be much more emphasis in school around apprenticeships. Schools should be pushing them more. Doing an apprenticeship is fantastic.'*

In oral evidence, on 25 April 2023, Dr Liz Ann Trant, Director, National Apprenticeship Office, recommended that national and regional awareness and promotional campaigns include STEM apprenticeships alongside other options and include information on the specific opportunities and benefits offered to those choosing the apprenticeship route. Also, she recommended that additional targeted initiatives are developed to promote STEM opportunities and apprenticeships in STEM areas to reach young people from the earliest age.

At the same meeting, Mr Andrew Brownlee, CEO, stated that SOLAS and the ETBs have worked to provide more access to taster modules during transition year to encourage interest and skills development in STEM-related areas and to signpost future potential pathways. Areas of focus have included mechanics, aviation, electrical, plumbing, green skills and healthcare. As part of their strategic performance agreements with SOLAS, all ETBs are required to develop the transition year offerings further in the next two years. He explained that SOLAS has also been working closely with the NCCA to further embed this approach.

RECOMMENDATIONS: POST-PRIMARY EDUCATION

10. Junior Cycle Short Courses should be expanded to include more integrated STEM options.

11. Foundation level Irish at Junior Certificate in Mathematics should be retained to ensure that weaker students engage with the subject in a positive way.

12. The Department of Education should publish revised specifications for Physics, Chemistry and Biology at Senior Cycle by the end of 2023. A key priority should be that the revised syllabus for each subject is far more detailed with comprehensive instructions for teachers. The Committee recommends that the National Council for Curriculum and Assessment (NCCA) reviews the proposed design of the new specifications to ensure teachers are properly supported and students are taught to the highest professional standards.

13. Modularisation should be introduced for STEM subjects, to comprise:
    - Written assignments prepared in class under the class teacher's supervision, marked by the State Examinations Commission (SEC), with a broad range of options to give

student's the maximum freedom to select topics as a way of encouraging self-directed learning.

- An oral presentation using power point slides on the selected topic, recorded and assessed by the class teacher with external validation checks by the State Examinations Commission (SEC).

It is recommended for all subjects, that 2 Modules are completed over Senior Cycle, one in 5th and 6th Year. A written examination would then take place in each subject at the end of 6th year. The Marking Scheme should be determined by the Department of Education in liaison with the National Council for Curriculum and Assessment (NCCA) and the State Examinations Commission (SEC).

14. All Senior Cycle students should have the option of combining traditional Leaving Certificate (LC) and Leaving Certificate Applied (LCA) STEM Subjects. To this end, the Department of Education, in liaison with the National Council for Curriculum and Assessment (NCCA), should review the LCA Model, to identify how the evidentially successful parts of it regarding STEM could be incorporated into the traditional Senior Cycle.

15. Supporting integrated STEM work in Junior Cycle will require teachers with understandings across Physics, Chemistry and Biology. Teaching Council Registration requirements should stipulate that teaching credits are required in all three subjects to teach Science at Junior Cycle.

16. An *Expert Working Group on Teacher Supply for STEM Subjects and Computer Science* should be established by the Department of Education in Quarter 4, 2023. The Group should be chaired by an external expert and comprise teachers, the National Council for Curriculum and Assessment (NCCA), Relevant Teacher Training Institutions, Subject Matter Experts and senior officials from the Departments of Education and Further and Higher Education, Research, Innovation and Science.

17. In the interim, the Department of Further and Higher Education, Research, Innovation and Science should seek Expressions of Interest (EOI) from Higher Education Institutions regarding the provision of Post Graduate Accreditation to teach Computer Science at Senior Cycle to Honours level.

18. The Ministers for Education and Further and Higher Education, Research, Innovation and Science, should jointly review the Teaching Council Regulation that precludes Technological Universities from 'taking the lead' in Teacher Training Provision and amend the legislation, if necessary.

11. The Department of Education should develop a *National Programme for High Performing Students*[3] in Primary and Post Primary Schools to enable them to reach their full potential. The Department should engage with the Centre for Talented Youth (CTYI) in Ireland at Dublin City University (DCU) in this regard with a view to agreeing on a Service Level Agreement (SLA) that would include, *inter alia*, Training for Teachers in Programme Delivery. The Programme should be rolled out nationwide so that all relevant students have equal access to it.

12. The State Examinations Commission (SEC) should review the Junior Cycle and Senior Cycle Mathematics Papers so that students with low or poor literacy levels are not placed at a significant disadvantage.

13. Integrated STEM options in Transition Year (TY) should be available in all Post Primary Education Settings to help promote a STEM Culture.

[3] High Performing Students should be identified primarily on the results of the Drumcondra Standardised Tests in English and Mathematics from Second Class and onward.

14. An Integrated STEM project should be incorporated into the Transition Year curriculum and awarded credits towards the terminal Leaving Certificate Examination Result in the relevant subject.

15. The Department of Education should establish an *Online Streaming Initiative* within DEIS Schools as a pilot initiative, so that students have the choice to study all STEM subjects at Higher Level. The selected schools should have a geographic spread. Pending evaluation, the Initiative should then be rolled out nationwide as a Model of Best Practice. To this end, comprehensive training should be provided to participating teachers as well as Compensatory Allowances.

16. The Senior Cycle Curriculum should prepare students for Apprenticeships, Further Education and entering the Workplace.

17. The Ministers for Education and Further and Higher Education, Research, Innovation and Science should develop a joint *Apprenticeship Communications Campaign* that can be rolled out to all Secondary Schools.

18. Whole School Inspections (WSE) should be used to track schools progress in promoting Science, Technology, Engineering and maths (STEM) and offer support to nonparticipating schools.

19. A Mandatory Module on supporting integrated STEM Education should be provided to all Guidance Counsellors as part of their Continuous Professional Development (CPD). It should include, *inter alia,* awareness of STEM roles, career opportunities and role models.

CHAPTER 3 TERTIARY EDUCATION

CAPITAL AND INVESTMENT

In its submission, the Irish Universities Association (IUA) noted that 'there has been a significant lack of capital investment in IUA universities since the onset of the financial crisis, resulting in sustained pressure on campus spaces and facilities for teaching and learning, research, and student services. Over the past decade student numbers in the higher education sector have grown by 25%. Exchequer capital funding available to IUA universities over that period however has effectively been limited to two funding calls of c. €80m each under the Higher Education Strategic Infrastructure Fund. In the absence of Exchequer funding, universities have had to borrow heavily over this period to meet this increase in capital infrastructure needs. Some universities are now at the end of their borrowing limits and will not be able to meet the expected demographic increases coming over the next decade.

Significant Exchequer capital investment in IUA universities is now required to meet the demographic pressures and changing needs of students. In the absence of that funding, the continued capacity of universities to expand STEM provision and produce high quality graduates will be significantly impacted.'

Professor Lisa Looney, DCU, expanded on this further stating that '*to capitalise on STEM education to address skills needs, including skills focused on the challenges of climate change and the digital transition, we need a policy focus on scaling the provision of STEM programmes at third level. We also need a broader strategy for lifelong learning, including reskilling and upskilling to unlock the potential for STEM participation and inclusion. IUA institutions have been proactive. We have absorbed a significant number of additional STEM enrolments over the last six years. Despite this and the support of the Human Capital Initiative, funded from the National Training Fund, shortages of STEM graduates exist very broadly. If anything, emphasis on areas such as ICT and engineering seems to have reduced and policy shifted to shortages in health-related disciplines where Government is the main employer. We cannot afford to reduce emphasis on the physics, sciences, ICT and engineering aspects of STEM. We are far from meeting the skills challenge currently and that has a very negative impact on competitiveness.'*

The HECA submission noted that although higher education offers specialised courses in STEM fields, it's crucial to provide not only advanced degrees and post-graduate courses in these subjects, but also interdisciplinary modules that can be integrated with other areas of study. It further noted that Microcredentials will play a key role in enabling this type of dual-skilling and will also aid in enhancing the digital literacy of adults as well as lifelong learning and upskilling.

It stated that HECA member HEIs are strong supporters and providers of existing programmes such as Springboard+ and Human Capital Initiative (HCI) Pillar 1 which offer upskilling and reskilling opportunities in STEM career. It noted that to level the playing field for underrepresented groups and address the digital divide, there is a need to increase the provision, methods and integration of STEM into tertiary education. It cited the increasing importance of technology in today's world and how it is crucial that everyone has access to the skills and knowledge necessary to thrive in the digital age.

The EGFSN submission stated that expanding the pipeline of initial entrants into STEM professions will need to be accompanied by a robust approach to the regular upskilling of the existing STEM workforce across Further Education and Training and Higher Education, to ensure it keeps pace with technological, environment and scientific trends.

It made the point that this is already a key priority of Ireland’s approach to lifelong learning, which is extensively supported through the either free or heavily subsidised programmes funded through the National Training Fund. These include Springboard+, the Human Capital Initiative, Skillnet Ireland’s enterprise led training networks, and a range of programmes across the Education and Training Board network. It highlighted that the new industry consortia led apprenticeships, which are now offered across STEM disciplines including Biopharma, Engineering, and ICT, are also offering reskilling pathways for those transitioning from other job roles or sectors, as well as graduates from initial education.

The TUD submission noted that. as the STEM sector is fast evolving, investment is required to keep tertiary educational institutions equipped to teach the most up-to-

date knowledge. Investment funding for infrastructure and equipment, ideally on a multi-annual basis, is important to enable optimal planning of educational offerings.

It also contended that Level 9 and level 10 education are quickly becoming the new norm for high skilled jobs in the STEM sector. It advised that Investment in research infrastructure and funding streams is required to upskill level 8 STEM graduates to attain higher degrees (in particular, in the areas identified in the National Research Prioritisation Exercise). It noted that sufficient funding schemes should be in place to support the parallel upskilling of employees through employment-based research.

In oral evidence, on 7 March 2023, Ms Beth O'Reilly, President, Union of Students in Ireland (USI) contended that '*There is also a need for an increase in the amount of STEM-focused programmes available at third level. This could involve creating new degree programmes in emerging fields like data science and cybersecurity, creating additional optional modules for students in these areas or expanding existing programmes to accommodate additional students.'*

Ms Claire McGee, IBEC, opined that *'investment in enhancing high-level STEM capacity across further and higher education. In addition to improving the pipeline and enrolment numbers across the tertiary and apprenticeship system, focus must also be on delivering a high-quality STEM education experience, with a strategic capital investment programme for cutting-edge technology, equipment 28 MARCH 2023 17 and infrastructure. To educate, train and empower the next generation of scientists, engineers, architects, teachers, medical professionals, artists, apprentices and so on, Ireland's universities and colleges must have state-of-the-art equipment to provide a high-quality learning experience. IBEC has long advocated for greater investment in STEM education. The current unit of resource funding does not reflect the full economic cost of delivery. This must be addressed by the provision of capital infrastructure renewal, development and upkeep. Otherwise, universities and colleges will not be able to develop critical technology and digital skills. Innovative talent development models, such as the new consortium-led apprenticeships in STEM-related disciplines, need to be accessible and financially viable for all enterprises.'*

STEM RESEARCH AND INNOVATION

In its submission, Science Foundation Ireland (SFI) warmly welcomed and support the introduction of the Department of Further and Higher Education, Research, Innovation and Science (DFHERIS) Evidence for Policy Unit and associated Civil Service Management Board approval of a proposal to establish Civil Service Research Network (CSRN). It opines that the body has the potential to create a meaningful path for engagement between policy makers and the academic community.

The IUA submission made the point that '*the development of a research funding agency is an exciting opportunity to enhance links between higher education, schools, and the community. Championing the role of university researchers across the STEM disciplines, as well as engaging wider society in the role of STEM in addressing societal and economic needs can be better supported as a result. Irish universities have performed strongly in research and innovation, especially in securing recent EU Horizon 2020 and Horizon Europe funding. These successes build on the capacity of our universities to develop research-informed programmes at undergraduate and postgraduate levels, as well as to develop short courses such as micro-credentials to meet emerging skills needs.*'

EMPLOYMENT PRECARITY AND CAREER PATHWAYS

The SFI submission and others similarly contended that PhD candidates and postdoctoral researchers are the lifeblood of the research and STEM higher education system. It opined that without adequate support for those individuals so that they can thrive in their endeavours, there is a risk of destabilising that pipeline of talent. Interestingly, it noted that women are most likely to leave research during those early years of their career, often termed the 'leaky pipeline'.

SFI welcomed the capital infrastructure programme and recommended that appropriate balance is sought to support infrastructural and indirect costs of research, *and* to support the allocation of academic time to scholarship and preliminary and exploratory research.

It also recommended the identification of the high-level (PhD and postdoctoral) skills required for the future to create a national talent roadmap to help secure the country's ability to respond to future societal, public service and economic needs.

In its submission, Irish Federation of University Teachers (IFUT) 'welcomed the Oireachtas Committee Report, entitled *The Future Funding of Higher Education,* which includes an examination of the needs of those in precarious employment and atypical contracts in higher education. It quoted the Report where it states it is …..'*imperative that Irish Universities ensure their research staff have employment contracts that offer security of tenure, career progression pathways and salary scales that are commensurate with their qualifications and experience*.'

IFUT also stated that it is imperative there is sufficient funding of STEM education in higher education to enable a sustainable higher education system and ensure students and staff alike are enabled to achieve maximum educational outcomes, while ensuring that higher education remains able to deliver the highest standards of research and teaching in STEM subjects and continue to support Ireland's social and economic development.

In oral evidence, on 7 March 2023, Mr Frank Jones, General Secretary, Irish Federation of University Teachers (IFUT) outlined the stark reality of working in precarious employment '*we have a lot of people who make commitments far beyond what has been recognised in salary or a contract and remain within the sector at enormous personal cost. In many cases, we are coming across members who are in their late thirties before they secure contracts of indefinite duration or tenure and it is only then that they can start to purchase houses and start families. We are not losing them all but those we are keeping are being kept at enormous personal cost to themselves. A lot can be done. If the recommendations and decisions of this committee were acted upon, a lot would be done.'.*

The IUA submission made the point that the current review of State Supports for PhD Researchers is an opportunity to consider the full progression of students from primary through to research. It notes that doctoral education provided by our universities must meet an ever-growing need for research personnel across academia and industry. For example, 80% of natural sciences, mathematics and statistics PhD graduates felt their qualification was relevant or very relevant to their job highlighting the need for high-level research experience for the knowledge economy.

The TUD submission stated that '*Ireland has invested in Technological Universities to help deliver its national ambition for STEM but has not yet invested in the appropriate staffing of the sector. The recommendations contained in the recent OECD 'Review of Technological University Academic Career Paths, Contracts and Organisation in Ireland' need to be implemented by government, including both the academic workload model (to encourage greater research output) and the career framework (to enable the sector to compete for talent with longer established universities).'*

In oral evidence, on 28 March 2023, Dr Ruth Freeman, Director of Science for society, Science Foundation Ireland (SFI), reported that '*the Department of Further and Higher Education, Research, Innovation and Science is carrying out an ongoing review of the structures to support PhD students. In reality, the stipend to students has remained the same for many years and it has been highlighted that it has not kept up with the cost of living for students. As a result, and to quote some of the researchers that we fund, they are either unable to attract students to take up PhD positions or the pool of students they can attract is restricted to those who can perhaps stay in their parents' homes within commuting distance of the laboratory where they are going to do their work. The rising accommodation costs and the cost of living mean that those who do not have those supports are unable to take up these opportunities.*

The implications for us, as a society, are that we are excluding people from certain socioeconomic backgrounds from taking up these opportunities in STEM and we are not opening up the widest talent pool we can to build a world-class research system

here in Ireland. We, therefore, welcome the review. The review will look at a number of different lenses. In other European countries, PhD students are regarded as staff members whereas here they are treated as students. I think the review may look at that aspect but certainly the level of the stipend is the urgent issue today.'

LIFE LONG LEARNING, PROGRESSIONAL PATHWAYS AND CONTINUOUS PROFESSIONAL DEVELOPMENT (CPD)

The TUD Submission proposed the consideration of an alteration of the CAO points system, or development of pathways through Further Education establishments, to allow students with strengths in particular STEM subjects to gain access to relevant programmes at tertiary level.

The NAPD Submission opined that the creation of diverse pathways for students is essential to an integrated system to allow for students to follow their passion. It further stresses that diverse and varied pathways will create more opportunities for students and create the conditions to break down barriers to studying STEM courses in tertiary education. In addition, many students, who all mature at different rates, can be excluded from access to STEM courses based on a matriculation requirement that is based on their performance in the Leaving Certificate. It notes that a significant number of mature students enrol in STEM courses that had previously failed to gain access to the course directly following their Leaving Certificate or had dropped out proving diverse pathways will likely increase participation in STEM courses at tertiary level.

In its submission, Enterprise Ireland (EI), opined that increasing the number of students choosing STEM pathways in Further and Higher Education, and the quality of that education across all levels of the National Framework of Qualifications (NFQ) is key to any policy statement on STEM education. It also stated that it is equally important to ensure people sustain their involvement in STEM education throughout their careers by promoting lifelong learning, progression pathways and continuous professional development.

The submission referred to life-long learning and noted that is essential to sustain and develop a skilled workforce that can adapt and respond to changing skills needs.

To achieve this there must be clear and integrated pathways between Further and Higher Education. It stressed that this focus is very important to support inclusion and diversity, building a pathway of progression that is accessible and supports individuals to build their career and provide development opportunities.

In oral evidence, on 28 March 2023, Mr Neil McDonnell, Chief Executive, Irish Small and Medium Enterprises (ISME) made an interesting point '*While Ireland's performance at secondary and tertiary levels is good by international comparison, this comes at the expense of a significant degree of overeducation relative to job requirements. This is estimated by the Economic and Social Research Institute, ESRI, and the Institute of Labor Economics as being at 30% in Ireland. On its own that would not be problematic, but we see our academic education system outperforming while vocational and lifelong learning underperform. This should be at the forefront of the advancement of STEM in the Irish education system in future.'*

Several submissions refer to the value of the National Youth Council of Ireland (NYCI) STEAM in Youth Work Project and the National Adult Literacy Agency (NALA) proposed that it could be considered as an existing framework.

The IUA submission proposed a coordinated action plan that is inclusive of the significant role that higher education plays in meeting STEM skills needs cross-sectorally, through primary to tertiary. It stated that the plan for an integrated tertiary sector is an opportunity to achieve this aim.

It also referred to the need for a broader strategy for lifelong learning, including re-skilling and up-skilling, to unlock the potential for STEM participation and inclusion across an individual's educational and careers journey.

The EGFSN stated that expanding the pipeline of initial entrants into STEM professions will need to be accompanied by a robust approach to the regular upskilling of the existing STEM workforce across Further Education and Training and Higher Education, in order to ensure it keeps pace with technological, environmental and scientific trends.

In oral evidence, on 28 March 2023, Dr Aisling Soden, Talent Transformation & Innovation Manager, Irish Development Authority (IDA), noted that '*We must also*

look for diversity within the talent pool to broaden it through alternative pathways, not only in the traditional degree route but in looking at apprenticeships, for example, the unified tertiary system, and at further and higher education linking up and developing programmes so that people can move through to their chosen career.'

In oral evidence, on 25 April 2023, Dr Peter Cullen, Framework Standards and Guidance Manager, Qualifications and Quality Assurance Ireland (QQI) noted that universities and higher education institutions provide the primary educational formation for many STEM disciplines, and it is important that all members of society who could benefit from this formation can avail of it. He pointed out that he dominant route into higher education is via the leaving certificate. He suggested that it may be useful to reflect on whether this route is overly dominant and consider further developing alternative pathways alongside it, such as those involving further education and training

FUTURE EXPANSION OF CRAFT AND NEW GENERATION APPRENTICESHIPS

Ms Beth O'Reilly, USI, noted that '*Given that not all students can, or wish to, attend a traditional university or college, support for apprenticeships and vocational programs should be improved by providing financial incentives to industry players to encourage them to take on apprentices. We need to see an expansion in the apprenticeship system to include more STEM fields, as well as financial support aimed at apprentices and trainees.'*

Mr. Michael Fitzgerald, ESB Networks, explained that '*For generations, the apprenticeship system has been part of our philosophy and ethos in the ESB. Our investment in apprenticeships and in-career training is critical to ensuring we have the requisite skills to maintain, develop and enhance the electricity system so it meets the needs of modern Ireland. The apprenticeship model has worked extremely well for the ESB….. We have always sought to contribute to the development of apprenticeships in Ireland and worked closely with SOLAS and other organisations in areas such as standards and progression routes. Diversity of intake is essential for ESB Networks. This year 25% of first-year apprentices are female. This is the largest group in the country….. To continue to achieve the necessary standards, we must*

attract the highest possible field of potential candidates at recruitment stage. Apprenticeship promotion is multifaceted…Apprentices advocate a diverse, attractive and rewarding way to "earn as you learn" to degree level or beyond. To achieve authenticity, the material is created on site in ESB Networks, using actual apprentices 22 JEFHERIS and staff. We are linking with the Irish Career Guidance Association to arrange familiarisation events in 2023 and beyond. Over the years we have invested heavily in our apprenticeship programme, including non-traditional apprenticeships. These investments have been rewarded with a stream of talent into the company that is crucial to our business and to serving the nation in a very different energy future.'

In oral evidence, on 18 April, Mr. Jamie Bermingham, gave a personal testimony supporting apprenticeships *' I am a newly qualified plumber and WorldSkills Ireland plumbing and heating champion 2022. I would like to begin by saying that my apprenticeship has been a life-changing experience for me. Not only has it helped me to acquire the necessary skills and knowledge to excel in my chosen field, but it has also opened doors to numerous opportunities and experiences that I never thought were possible. I am proud to say that I succeeded well in my apprenticeship, achieving distinctions in all my exams and qualifying with an overall distinction. This was a moment of great pride for me…'*

At the meeting, Mr Martin Scattergood related his personal journey to a successful apprenticeship *' I am a sheet metal worker and am now fully qualified now. At school, I liked science, technology, engineering and maths and I always preferred to be much more hands-on in my life. After doing the junior certificate examination……heard about the leaving certificate applied, LCA, through a friend……I moved school and took the LCA ….This opened doors into an apprenticeship for me. When I left school, I had done all the subjects in school. I had completed projects. I had a lot of worksheets and so on. We had done big projects in school, so I was able to go straight into an apprenticeship. As someone who struggled in a normal academic leaving certificate class, I think students should have different routes available to follow a more practical route in STEM.'*

RECOMMENDATIONS: TERTIARY EDUCATION

20. Department of Further and Higher Education, Research, Innovation and Science (DFHERIS) should establish the Civil Service Research Network (CSRN) by Q4 2024.

21. The issues of Staffing Levels and Precarious Employment in both the traditional and Technological Universities need to be reviewed urgently or by end of 2022 at the latest, by the Minister for Further and Higher Education, Research, Innovation and Science, in liaison with the Universities. Staffing Levels have not increased in line with extra students, courses and increased services provided by Third Level Institutes and, so, there needs to be an analysis / workforce plan of staffing requirements to restore staff levels. In addition, the Employment Control Framework is completely arbitrary and needs to be abolished. The aim must be to ensure there are sufficient staff at all grades to deal with the projected increase of students, extra courses and increased services. Regarding Precarious Employment, the Review should include an examination of Hourly Paid Academic Contracts, Researchers, Postgraduate Workers and outsourcing of Support staff roles.

22. An *Expert Working Group on Pathways from Further Education to Higher Education* should be established by the Minister for Further and Higher Education, Research, Innovation and Science. The Group should be chaired by an External Expert and be comprised of Senior Department and Higher Education Authority (HEA) Officials, the Irish Universities Association (IUA), the Union of Students in Ireland (USI), the Technological Higher Education Association (THEA), SOLAS, Industry Representatives and Staff Unions. The Group should identify current opportunities and barriers to progression from Further to Higher Education and establish how to develop links between both sectors that allow for more seamless progression.

23. The Higher Education Authority (HEA) should provide ring fenced funding to the Technological Universities (TU)s, as necessary, to ensure there is sufficient physical capacity and lecturer capability to deliver on the increased numbers of Craft and New Generation Apprentices. To this end:

- The Department of Further and Higher Education, Research, Innovation and Science (DFHERIS) should provide Short Term Funding to bridge the gap.
- From 2024, the Department should provide Multi Annual Funding through a new Apprenticeship Fund.
- The Higher Education Authority (HEA) should commence a Review of the Craft and New Generation Apprenticeship Building Requirements by Q3, 2022, with the aim of delivering the buildings required to ensure Apprentices are educated to the highest international standards within a 3-year period.

24. The cost of apprenticeships and lack of financial support provided to apprentices needs to be addressed, as follows:
    - Providing financial support to eligible apprentices through the SUSI Grants Scheme for periods of Block Release and for the purchase of expensive tools and equipment, where necessary.
    - New generation apprentices should receive the same financial payment from SOLAS as the craft apprentices.
    - Additional financial supports should be given to employers to facilitate hiring apprentices with disabilities, those from minority backgrounds and female apprentices.

CHAPTER 4 – FEMALE PARTICIPATION, DIVERSITY AND INCLUSION

In its submission, the Higher Education Authority (HEA) noted that 30% of students entering higher education for the first-time study STEM. Nonetheless, a large gender gap is evident. While 43% of men study STEM, 19% of women study STEM, representing a 24-percentage point difference.

The HEA submission also refers to *The National Access Plan – A Strategic Action Plan for Equity of Access, Participation and Success in Higher Education 2022-2028,* published in August 2022. It explains that the inclusivity goal in the plan is an objective to consider how to achieve a more diverse student population across all programmes and all levels of study, both undergraduate and postgraduate. This is relevant for STEM with data in the Plan showing that, for example, just 4.9% of new entrants doing Mathematics in 2019/20 were from disadvantaged areas compared to 19.1% from affluent areas. Over the lifetime of the National Access Plan, a range of key performance indicators will be monitored to assess progress, trends, and diversity across STEM fields of study.

The SFI submission remarked that women and girls are underrepresented in several areas of STEM. It stated that less females take up most STEM subjects including physics, engineering, applied maths and computer science and that many female schools offer a reduced range of STEM subjects.

It referred to 2019 data that shows that only 68% of female schools offer science subjects, other than maths and general science, compared to 94% of male schools. It noted, that in 3rd year, only 27% of girls take a STEM subject, other than maths or general science, compared to 73% of boys. It further cited a 2021 iWish survey that revealed over three-quarters of teenage girls cite lack of subject choices as a barrier to a career in STEM. Chemistry and Biology are the only two subjects where there are more females than males sitting the Higher Leaving Certificate exam. In all other STEM subjects, there are more males than females sitting the higher paper.

In its submission, the Irish Primary Principals Network (IPPN) made a pertinent observation. It noted that that the biggest challenge to the promotion of STEM is the

simplest one. If children – both girls and boys - are exposed to interesting, well thought-out, well-planned STEM lessons that build on their previous work, then they will be more interested in taking these subjects at second level. Research shows that, where interest is not developed by the end of primary, children do not take these subjects later.

The NAPD submission noted *that 'not all schools offer all subjects to all students. Some girls only schools do not offer woodwork or some of the other STEM subjects to students while access to the leaving certificate science subjects can be haphazard. While it is understandable that in smaller schools it may not be economically viable to offer all subjects where there is only small student interest in the subject, there is a responsibility to support the offering of STEM subjects to all students.'*

Mr Paul Crone commented that '*looking at the gender breakdown of the 2022 leaving certificate, where STEM subjects such as maths are offered universally the take-up is almost 50:50. It is probably 45:55 where girls are taking it at higher level. If you go to construction, technology or engineering, there is a much lower take-up. That is something we need to address. More and more girls are choosing STEM subjects and exploring the aptitudes they are discovering they have in these areas. We need to look at providing and offering these subjects universally to all students, rather than potentially making them go down the road to the boys' school just to access them. These subjects should be available in all schools.'*

In oral evidence, on 21 March 2023, Dr Maria Kyne, Dean of the Faculty of Engineering and the Built Environment, Technological University of the Shannon (TUS) Midlands Midwest, representing the Technological Higher Education Authority (THEA), expressed the considered view *'In talking to this committee, the Union of Students in Ireland emphasised diversity and the importance of a culture of inclusion in STEM and those are priorities we in the IUA echo. As an engineer and former executive dean of a faculty of engineering and computing, this is an area of particular interest to me. There are three short points I want to make around this area. We have had a sustained focus on women in STEM for more than 30 years. I know because I have been there for the past 30 years. This has delivered progress but at*

a frustratingly slow pace. We need to keep doing what we have been doing, but we need to add new thinking around things such as gendered perception of confidence, the difficulty of STEM, how we use role models and how career risk is perceived. We now have a much larger pool of young women with strong competence at higher mathematics than there was a decade ago, but that competence is not translating into a higher number of women choosing STEM at third level to the same degree. We should examine how that could be changed.'

Several submissions, including IOP, advocated for a fuller spectrum of data to be collected and published to identify and tackle underrepresentation. SFI recommended a consolidated approach to data collection which allows policy makers to understand the diversity of our research base and to ensure that it is representative of Irish society and can deliver solutions for society's needs.

In its submission, AONTAS recommended that the Departments of Education and of Further and Higher Education, Research, Innovation and Science implement systems which provides comprehensive national data collection on how learners from groups who have historically faced educational disadvantage progress through levels 8 – 10 National Framework of Qualifications (NFQ) in higher education in STEM-related disciplines.

Aontas also advocated that both Departments jointly commission qualitative research to look at the experiences of learners from these marginalised groups in STEM-related higher education disciplines and use findings to inform policy and practice on STEM education.

The IFUT submission expressed concern that, women continue to be underrepresented in science, technology, engineering, and mathematics (STEM) fields and in STEM leadership positions. It cited the statistics that 41 per cent of those graduating with a PhD in science, mathematics and computing are women — lower than in the EU, but nevertheless within a 60/40 definition of gender balance. However, that '…*disappears when we look at those who are permanent Stem academics (only 35 per cent of whom are women, compared with roughly half in the*

*EU). The picture becomes even more unbalanced at full professorial leve*l [*Irish Times 27th May 2022].*'

The EGFSN submission noted that gender imbalance is of course not unique to Ireland. However, it opined that domestically it is impacted by differences in subject choices at school level- a reflection of longstanding subject segregation between girls' and boys' secondary schools. It advised that when tertiary study and ultimately career options are being formed, this limits horizons around potential career pathways and ultimately the pipeline into relevant education and training programmes.

It also highlighted the fact that female participation levels vary by the branch of STEM- 33% of those in Science and Engineering occupations were female in 2021; this was highest for chemical, biological and physical scientists (50%), followed by 39% for Science and Engineering technicians, and 32% for Production, Design and QC Engineers. In the Construction professions, including civil engineering, the share of females is roughly 20%. In terms of ICT occupations, 24% of the workforce was female in 2021; 26% shares were recorded for ICT Specialists and Project Managers and IT Technicians, and 17% for Programmers and software developers. This is also reflected in the breakdown of recipients of employment permits for high level ICT roles, with males accounting for between 73% and 77% of permits over the period 2019-2023.

Professor Sarah McCormack made the compelling argument that '*encouraging women into STEM is crucial for economic growth and competitiveness. Engineering is a field that drives economic development through technological advancements and infrastructure improvements. By tapping into the talent pool of women, who make up half of our population, we can expand the workforce and drive economic growth. Studies have shown that companies with a diverse workforce, including gender diversity, tend to perform better financially and have a competitive advantage.'*

Professor McCormack proposed innovative ways to encourage female participation *'Representation matters. Having visible role models can inspire and motivate young*

girls and women to pursue careers in engineering and other STEM fields. Showcasing successful women STEM professionals as role models in schools, universities and workplaces can help challenge gender stereotypes and encourage more girls to consider STEM as a viable career option. Encouraging gender diversity requires not only changing mindsets but also implementing supportive policies and practices in educational institutions, workplaces and the engineering profession such as flexible work arrangements, mentorship programmes, diversity and inclusion initiatives and bias training programmes. Women offer different viewpoints, experiences and approaches to problem-solving, which can lead to more innovative solutions and improved decision-making. In a world that is facing complex challenges such as climate change, sustainable development and technological disruptions, we need diverse perspectives in engineering in order to develop innovative sustainable solutions that address the needs of all people.'

The TUD Submission outlined several initiatives to support inclusion and diversity in HEI participation, including support after graduation.

In its submission, Independent Living Movement Ireland (ILMI) noted that '*in considering the current and future approach of STEM, it is crucial to respect Ireland's commitments under the United Nations Convention on the Rights of People with Disabilities (UNCRPD) and particularly Article 24 of the Convention which articulates, "The State recognises that disabled people have the same rights as others to education"*.'

The submission referred to the lack of STEM subject choice at post primary level for students with physical impairment. It made the point that educators need to be made aware of the social model of disability, such as taking part in authentic Disability Equality workshops and talk directly with disabled students to ensure equal access to all STEM subjects as the disabled person is the expert in what they can and cannot do. It also stresses the need for flexibility in the use of Assistive Technology when required in practical classes and or the use of a personal assistant to carry out tasks on the professional direction of the student. It also points out this Model can be used effectively in encouraging and supporting students in Tertiary Education.

In its submission, the Disability Persons Network (DPO) representing the Irish Deaf Society (IDS) and Disabled Women Ireland (DWI) DPOs, noted that '*It is crucial to address the disproportionate impact of classes over quota sizes on students who require additional support, such as those with specific learning differences like dyscalculia. Impairment-related challenges in STEM, including limited hand-eye coordination, must be acknowledged, and accommodated to provide equal opportunities for all students. Proactive universal design and support, rather than relying solely on self-advocacy, are essential for creating inclusive learning environments. Intersectional challenges faced by disabled women and girls in STEM education must be recognised and addressed, while efforts to bridge educational gaps and ensure equal access should be prioritised.*'

In relation to Deaf students several areas must be addressed. Insufficient funding for the development of ISL vocabulary in STEM hinders Deaf students' comprehension and engagement with these subjects. The limited proficiency of teachers in ISL further impedes effective communication and support for Deaf students in STEM education. Resource disparities in Deaf schools restrict the opportunities for Deaf students to pursue their interests in STEM subjects. The lack of response from the Department of Education regarding our proposals underscores the need for transparent communication and prompt action. Furthermore, the absence of accessible online STEM resources in ISL limits Deaf students' ability to engage in self-learning. Finally, we emphasise the importance of consulting Deaf experts and involving DPOs in decision-making processes to ensure that the rights and needs of Deaf individuals are properly addressed.'

RECOMMENDATIONS: FEMALE PARTICIPATION, DIVERSITY AND INCLUSION

28. An *Expert Working Group on STEM Subjects to Increase Female Participation, Diversity and Inclusion* should be established by the Department of Education to review current policy and teaching of these subjects from Primary School up to Senior Cycle. The Group should be chaired by an external expert and comprise teachers, the National

Council for Curriculum and Assessment (NCCA), Subject Matter Experts, industry representatives, disability representatives and senior officials from the Department of Education.

29. The Department of Further and Higher Education, Research, Innovation and Science Education should establish a Consolidated System for the compilation of disaggregate Data Collation and Measurement on the researchers to include gender, disability, ethnic minority and economic status. The data should also record the nature of individual research being undertaken and the proposed outcomes. This data should be used to inform the development of educational policy on an ongoing basis.

30. The Departments of Education and Further and Higher Education, Research, Innovation and Science, in liaison with the relevant Higher Education Institutions (HEI)s, should recruit Disabled, Ethnic Minority and Economically Disadvantaged Students on Initial Teacher Education (BED) and Master of Education (MED) courses that qualify them to teach STEM subjects at Post Primary level. Students would receive bursary's and be prioritised for student accommodation.

CHAPTER 5 – DIGITAL STRATEGY IN EDUCATION TO SUPPORT STEM

IMPLEMENTATION OF NATIONAL DIGITAL STRATEGY

In her submission, Ms. Norma Foley TD, Minister for Education, pointed out that the STEM Education Policy Statement and the Digital Strategy for Schools are intertwined. She noted that they complement and reinforce each other to encourage broader participation and enhance STEM and digital learning for all learners. She continued '*They acknowledge that in order for this to be achieved, school leaders and teachers require the necessary subject matter knowledge, pedagogical content knowledge and the appropriate skills, confidence and competence to embed STEM and digital skills in learning, teaching and assessment in the classroom.*

It is further acknowledged that schools must continually evolve, improve and learn from best practice in relation to STEM and digital education in order to ensure sufficient skills within the teaching profession to respond to current and future developments. It is recognised in the STEM Education Policy Statement and the Digital Strategy for Schools that the embedding of STEM and digital skills across the school system requires the provision of necessary professional supports and opportunities for teachers and school leaders such as high quality induction and professional learning, information resources and funding.'

DIGITAL LEARNING AT PRIMARY AND POST PRIMARY LEVEL

IPPN submission made the point that of the aims of the STEM strategy are to be realised, financial supports to schools for ICT and curricula must be reviewed and enhanced and backed up by access by all schools to skilled IT support.

The NAPD submission referred to the fact that new subjects have been introduced into the Leaving Certificate, including Computer Science. However, in many schools the expertise among existing staff members is limited in order to deliver the subject to students.

The NAPD submission emphasised that '*the upskilling of teachers is a significant challenge for schools, along with securing the expertise to manage the infrastructure*

in the schools. The priority for schools is the use of technology to enhance the learning experience for the student. The quality and continuity of that learning are dependent on the reliability of the infrastructure and hardware. Schools are not appropriately resourced to maintain the network infrastructure and different schools manage this in different ways. To ensure the embedding of STEM skills into every aspect of the school system, provision will need to be made for technical support for schools to manage the physical infrastructure.'

In her submission, Dr Ann Marcus Quinn, Lecturer in Technical Communication and Instructional Design, University of Limerick, highlighted the fact that a growing number of schools require students in first year to have a device in order to carry out classroom tasks in many of their subjects. She noted that tasks requiring a device are also detailed in some of the textbooks used in school. Yet, the Department of Education has not resourced students and teachers by providing the requisite devices.

She recommended that The Department of Education should consider a centralised approach to both the procurement and provision of digital devices and the necessary ICT systems.

EI contented that to deliver on Ireland's STEM Education Policy, it is imperative that all education providers are equipped with adequate infrastructure (including high-speed broadband and appropriate digital technologies/learning tools) that facilitates the delivery of high-quality STEM Education. They recommended that STEM teachers/instructors should be given every opportunity to develop and upskill to ensure all students are exposed to the highest quality learning possible. To facilitate this, STEM education staff at all levels must be provided with continual professional development opportunities, particularly as skills, technology and education practices evolve. As such, it is vital that the Digital Strategy for Schools to 2027 is implemented and progress/targets are constantly reviewed to ensure relevance.

The EGFSN noted that the development of the longer-term pipeline for digital skills is being addressed through commitments under the *Digital Strategy for Schools,* such as digital literacy and computer science programmes at primary and secondary level, and technology enhanced learning strategies across FET and Higher Education.

It stated that implementation and realisation of the ambitions in the *STEM Education Policy Statement*- in particular around female participation- and the broader rollout and resourcing of the Computer Science Leaving Certificate programme can play a key role in fostering the ICT Skills pipeline. This should include the better resourcing of girls' schools to facilitate STEM and Computer Science provision.

It warned that the expansion of STEM provision, however, could be frustrated by difficulties in recruitment of a pool of specialist teachers for STEM and computer science.

The TUD Submission recommended the provision of funding to support the acquisition of Virtual Reality and Augmented Reality equipment by primary and secondary schools to support STEM education and to equalise the exposure of all students to its practical aspects.

Dr Cornelia Connolly stressed that in order to enhance Ireland's skills and competences for the digital era, opportunities to learn basic digital skills must be provided from an early age. These include computing education, along with comprehensive knowledge and understanding of data-intensive technologies, such as Artificial Intelligence (AI). The submission noted that Computer Science (CS) curricula are being introduced in education systems throughout the world, offering young people the opportunity to move away from being passive users of computers to becoming designers and to developing a deep understanding of how technology works.

It further noted that while young people are often assumed to be 'digital natives' who can pick up computer skills with ease, her research indicates this is not the case. She reported that '*While students have a high level of access to smart technologies, teachers report that their technical use and understanding of computers is much lower, with students struggling to even turn on a computer or use a mouse. To address this, teachers say that digital education needs to be introduced at an earlier age. The research also raises questions in relation to equity of access, with male-female ratio of 78:22 among students who studied CS for Leaving Certificate in 2022.'*

Finally, it proposed that CS needs to be integrated across all levels in the formal education system. Dr Connolly proposed that '*we need to articulate and implement a strategy for the integration of CS through the continuum from primary school to Senior Cycle. We need to make space in the curriculum to include foundational CS concepts in order to develop these key skills and provide the resources to develop a curriculum that prepares students fully for the digital future.'*

Mr. John Irwin, referring to the teaching of Computer Science, commented '*That might be because they were teaching maths or some of the technological subjects and then took an interest in computer science and brought it in and developed it within the school. Again, it is a bit like the courses that have been run in Limerick for upskilling people in mathematics and so on. It is to upskill people who are currently in the system, as that is often a better mechanism. Now it is on the curriculum we will possibly see undergraduates begin to come through into the educational sphere.'*

Ms Caitlin Faye Maniti spoke about the need for additional resources '*the lack of resourcing and funding, newer, smaller subjects such as computer science need to become more mainstream. To do this, we need the infrastructure and teacher supply. Computers and coding are popular among students as hobbies, but to properly support leaving certificate computer science and junior cycle coding, we must look at the bigger picture. To put it simply, we do not have enough teachers available. Students can enter a plethora of different computer science-related competitions from the BT Young Scientist and Technology Exhibition to SciFest to VEX Robotics. However, the majority of students will not get an opportunity to study computer science as a subject because it will not be offered at their school. The ISSU recommends that there be an increase of investments in facilities for carrying out these STEM subjects'.* Her arguments were echoed by other witnesses and in written submissions.'

Dr Connolly noted that '*In recent years, the Irish education system has embraced CS by bringing it into the curriculum. Nevertheless, we are a long way off making this important subject available to all students. Equity of access is a matter of concern. Currently, CS at senior cycle is limited by the low number of post-primary*

schools offering coding at junior cycle and by a significant shortage of teachers qualified to teach the subject. The capacity of the Irish education system to facilitate CS education is highly contested, with constraints being placed on school timetables. Coupled with this is the low level of awareness and a pervading misunderstanding of what the discipline is and what it is not.'

Dr Ann Marcus Quinn referred to the provision of digital devices for students and proposed that '…*changing the current systems to improve the value of these purchases for both teachers and students at post-primary level is critical if equity of the digital experience is to be achieved. The Department should consider a centralised approach to both the procurement and provision of digital devices and the necessary ICT systems in order to support well-informed digital school policies and investments. The Department should also provide a recommendation regarding a common minimum standard for both student and teacher devices. A circular was published in 2017 providing recommendations on uniform purchases. A similar approach is necessary for the purchase of technology and associated services until a centralised approach and formal tendering process can be devised.'*

DIGITAL LEARNING AT TERTIARY LEVEL

The EGFSN advised that Further Education and Training (FET), Higher Education and lifelong learning response, should build on the three ICT Skills Action Plans since 2012. In particular, the close cooperation between Government, industry and the education and training sector, in order to attract a pipeline of new entrants into ICT programmes, maximise the capacity and investment in education and training in this area, and provide the upskilling pathways that ensure Ireland's pool of ICT professionals can keep pace with technological trends.

In oral evidence, on 25 April 2023, Mr. Paddy Howard, Principal Officer, DFHERIS, referred to digital skill and dimension 3 of the national digital strategy that sets out the importance of focusing Ireland's skills policy on getting digital skills at every level, including high-level digital skills, digital skills for the labour market and digital skills for society. He stated that this focus is vital so that Ireland can be an international leader in the digital economy. He noted that the Department has underpinned the national digital strategy by setting two overall targets. The first of these is to increase

the number of learners who graduate with higher level digital skills to more than 12,400 graduates, apprentices and trainees. The second target is to increase the share of adults 26 JEFHERIS in Ireland with at least basic digital skills to 80%.

RECOMMENDATIONS: DIGITAL STRATEGY IN EDUCATION TO SUPPORT STEM

31. The Department of Education should publish an Action Plan to implement the Digital Strategy for Schools to 2027 by Q4 2023.

32. The Department of Education should develop *A National Online Learning Programme*, to be rolled out to all primary and secondary schools, as a matter of urgent priority, to include:
    - One centralised Learning Platform.
    - Appropriate support and training for all principals and teachers and parents who are home schooling.
    - Remote device purchase that ensures disadvantaged students have access to devices for online learning.
    - Adequate broadband for online learning.
    - Provisions for Blended Learning, and
    - Transition Measures for Schools as the Plan is rolled out.

33. Senior Cycle students should be allowed complete their Senior Cycle examinations and assignments on a computer or other appropriate digital device from 2024 onwards.

34. Digital literacy classes should be introduced from Junior Cycle onwards from September 2024 to ensure all students are digitally literate. Teachers should be provided with training in this area as part of their Continuous Professional Development (CPD) with financial allowances for teaching Digital Skills.

APPENDIX 1: LIST OF SUBMISSIONS

Written submissions were received from the following organisations and individuals.

1. Airfield Estate
2. AMBER, Science Foundation Ireland (SFI) Research Centre for Advanced Materials and BioEngineering Research
3. An Chomhairle um Oideachas Gaeltachta & Gaelscolaíochta (COGG)
4. AONTAS
5. Association of Community & Comprehensive Schools (ACCS)
6. Association of Secondary Teachers Ireland (ASTI)
7. Department of Education
8. Department of Further and Higher Education, Research, Innovation and Science
9. Disability Person's Network (DPO)
10. Dr Áine Hyland, Emeritus Professor of Education, University College Cork (UCC)
11. Dr Ann Marcus-Quinn, Lecturer in Technical Communication and Instructional Design, University of Limerick (UL)
12. Dr Cornelia Connolly, Associate Professor, School of Education, College of Arts, Social Sciences & Celtic Studies, University of Galway
13. Dr Margaret Leahy, Head of the School of STEM Education, Innovation & Global Studies, and Professor Hamsa Venkat, Professor of STEM Education for Primary and Early Childhood Education, Institute of Education, Dublin City University (DCU)
14. Dr Sarah McCormack, Professor of Environmental Engineering, Department of Civil, Structural and Environmental Engineering, Trinity College Dublin
15. Education and Training Boards Ireland (ETBI)
16. Engineering Technology Teachers Association (ETTA)
17. Enterprise Ireland (EI)
18. Expert Group on Future Skills Needs (EGFSN)
19. Higher Education Authority (HEA)
20. Higher Education Colleges Association (HECA)
21. Independent Living Movement Ireland (ILMI)
22. Industrial Development Authority (IDA)

23. Institute of Physics (IOP)
24. Irish Business and Economic Confederation (IBEC)
25. Irish Congress of Trade Unions (ICTU)
26. Irish Federation of University Teachers (IFUT)
27. Irish Mathematics Teachers' Association (IMTA)
28. Irish National Teachers Organisation (INTO)
29. Irish Primary Principals Network (IPPN)
30. Irish Research Council (IRC)
31. Irish Science Teachers Association (ISTA)
32. Irish Second Level Students Union (ISSU)
33. Irish Small and Medium Enterprises (ISME)
34. Irish Universities Association (IUA)
35. Joint Managerial Body (JMB)
36. National Adult Literacy Agency (NALA)
37. National Apprenticeship Office (NAO)
38. National Association of Principals and Deputy Principals (NAPD)
39. National Children's Science Centre (NCSC)
40. National Council for Curriculum and Assessment (NCCA)
41. National Parents Council Primary (NPC)
42. Professional Development Service for Teachers (PDST)
43. Quality & Qualifications Ireland (QQI)
44. Science Foundation Ireland (SFI)
45. Shane O'Connor and Liam Carew, Young Scientists of the Year, Abbey School, Tipperary
46. SIPTU
47. SOLAS
48. State Examinations Commission (SEC)
49. Teachers Union of Ireland (TUI)
50. Technological Higher Education Authority (THEA)
51. Technological University Dublin (TUD)
52. Union of Students Ireland (USI)

APPENDIX 2: ENGAGEMENT WITH STAKEHOLDERS

On 28 February 2023, the Committee held a roundtable discussion with Association of Community & Comprehensive Schools (ACCS); Joint Managerial Body (JMB); National Association of Board of Management in Special Education (NABMSE); and Education and Training Boards Ireland (ETBI)

The debate can be accessed here

On 7 March 2023, the Committee held roundtable discussions with National Association of Principals and Deputy Principals (NAPD); Union of Students Ireland (USI); Irish Second Level Students Union (ISSU); Association of Secondary Teachers Ireland (ASTI); Irish National Teachers Organisation (INTO); Teachers Union of Ireland (TUI) and the Irish Federation of University Teachers (IFUT)

The debate can be accessed here

On 21 March 2023, the Committee held roundtable discussions with Irish Science Teachers Association, (ISTA); Irish Maths Teachers' Association (IMTA); Engineering Technology Teachers Association (ETTA); Irish Universities Association (IUA); Technological Higher Education Authority (THEA) and the Higher Education Colleges Association (HECA).

The debate can be accessed here

On 28 March 2023, the Committee held roundtable discussions with Science Foundation Ireland (SFI); Irish Research Council (IRC); Institute of Physics (IOP) Economic and Social Research Institute (ESRI); Industrial Development Authority (IDA); Enterprise Ireland; Irish Business and Economic Confederation (IBEC) and Irish Small and Medium Enterprises (ISME)

The debate can be accessed here

On 18 April 2023, the Committee held roundtable discussions with Dr Cornelia Connolly, Associate Professor, School of Education, College of Arts, Social Sciences & Celtic Studies, University of Galway; Dr Ann Marcus-Quinn, Lecturer in Technical Communication and Instructional Design, University of Limerick (UL); Dr ÁINE Hyland, Emeritus Professor of Education, University College Cork (UCC); Dr Sarah McCormack, Professor of Environmental Engineering, Department of Civil, Structural and Environmental Engineering, Trinity College Dublin; Dr Margaret Leahy, Head of the School of STEM Education, Innovation & Global Studies and Professor Hamsa Venkat, Professor of STEM Education for Primary and Early Childhood Education, Institute of Education, Dublin City University (DCU); Mr Shane O'Connor and Mr Liam Carew, 2023 Young Scientists of the Year and Mr Jamie Bermingham and Mr Martin Scattergood, World Skills Award Winners

The debate can be accessed here

On 25 April 2023, the Committee held roundtable discussions with Department of Education Officials, National Council for Curriculum and Assessment (NCCA); State Examinations Commission (SEC); Department of Further and Higher Education, Research, Innovation and Science (DFHERIS) Officials, Higher Education Authority (HEA); SOLAS; the National Apprenticeship Office (NAO) and Quality & Qualifications Ireland (QQI)

The debate can be accessed here

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