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

Submission to the Joint Committee on Education, Further and Higher Education, Research, Innovation and Science by the Irish Universities Association (IUA)

1. Introduction and Context

The Irish Universities Association (IUA) welcomes the opportunity to provide a submission to the Oireachtas Joint Committee on Education, Further and Higher Education, Research, Innovation and Science on the future of Irish STEM education. Across the IUA's eight university members STEM enrolments have witnessed positive growth despite continued underinvestment in the sector. The universities have a key role to play in increasing diverse participation in STEM and believe that this review provides renewed impetus for investment, cross-sectoral coordination, and greater outreach.

2. Enhancing high-level STEM capacity

Across public higher education STEM enrolments have only marginally increased from 2015/16 to 2021/22. Across engineering, manufacturing, and construction (EMC), information and computer technology (ICT), and natural sciences, mathematics, and statistics (NSMS), the overall proportion of total enrolments has increased during that period from 27.9% to 28.2%. If agriculture, forestry, fisheries, and veterinary (AFFV) is included[1] this increases from 29.6% to 29.9%.

However, while the system-wide data is relatively flat, there have been very encouraging increases in STEM numbers across the eight IUA universities. STEM enrolments have increased from 40,554 to 47,171 during the 2015-2022 period, a positive increase of over 16%. This compares favourably to overall total enrolments in the same universities of 146,514 (2015/16) to 165,725 (2021/22), an increase of 13%. During that same period, the female proportion of total STEM enrolments rose from 13,247 to 17,728, representing a rise from 32.7% to 37.6%.

[1] For the purposes of this submission, we have focused on the three core STEM fields (EMC, ICT, and NSMS) based on ISCED and OECD classifications. We note that the STEM Education Policy Statement also includes health and welfare, which we would view as a distinct field from STEM requiring additional targeted approaches as part of wider reforms.

The existing STEM Education Policy[2] does not adequately include or address the role of higher education; however, we recognise the considerable role of early childhood, primary, and secondary education in shaping motivations, interests, and skills for STEM at tertiary level. Developing curiosity, inquisitiveness and problem-solving throughout the school curriculum will enhance the potential for increased STEM applications and admissions in future. The Policy recognises that this inquisition is fostered 'in-school, out-of-school, and beyond school'. Often our universities are centrally involved in STEM related initiatives and activities that supports this approach, collaborating in partnership with schools, enterprise, government, researchers, and the wider community.

University outreach and engagement within the school sectors, including on initiatives such as Science Week and the BT Young Scientist and Technology Exhibition, as well as supporting many competitions and careers fairs across the country that aim to increase awareness and uptake of STEM related study or employment. Furthermore, STEM educators play a significant role in increasing new knowledge, understanding, and awareness of societal challenges across scientific fields, including climate action, public health, and digital transformation. Academics across our universities are ably meeting the challenges of tomorrow while also nurturing learning and inquiry among the student population.

Mathematics and the natural sciences are core underpinning subjects across STEM fields and there have been positive trends in uptake of higher-level Leaving Cert STEM subjects, including in Mathematics. The continuing upward trend of students taking Computer Science as a Leaving Cert subject is also encouraging. The subject has a wider benefit of developing computational thinking regardless of whether these students choose an ICT programme at third-level or not. The IUA encourages government to ensure Computer Science is offered broadly across the second-level sector and to ensure training for secondary school teachers to upskill within this area is funded. Furthermore, any successor strategy to the Third ICT Action Plan 2017 – 2022 will need to reflect the growing need for digital skills across all disciplines, as well as the work of the universities to embed digital skills across their curriculums, not just in STEM.

The overall scale of the challenge cannot be underestimated, with recruitment shortages across STEM-related industries including in the green economy, cybersecurity, accounting, and pharmaceuticals. Student progression rates in ICT and engineering, manufacturing and construction remain lower than for other disciplines, and while our universities have worked proactively to address this issue, a more integrated approach is required between second and third levels to ensure students are adequately

[2] STEM Education Policy Statement (2019). Department of Education. Available at: https://www.gov.ie/en/policy-information/4d40d5-stem-education-policy/

prepared for progression. While skills gap data is a key indicator of the need to build STEM capacity, developing national strategic approaches to STEM cannot be based on student recruitment alone.

The increasing role of lifelong learning, and a shift in focus to upskilling and reskilling for varied and evolving career pathways, provides a new lens through which to view STEM participation. As well as opportunities to improve career guidance and STEM engagement among primary and secondary level students, there are also increased pathways for mature learners to engage with STEM for the first time or to re-engage with STEM after a period out of education. The IUA MicroCreds project demonstrates the potential for short courses of study that engage learners in higher-level skills, provided by experienced academics, co-created with enterprise, and underpinned by a strong university research culture. For example, there has been a significant upward trend in the proportion of females undertaking part-time STEM courses over the age of 24. Flexible and part-time learning pathways are a crucial opportunity to support women returning to the workplace after a period of care leave or to support women to change careers in to STEM related work. The National Skills Strategy, strengthened enterprise engagement, and a clear plan to spend the National Training Fund surplus, can provide the scaffolding for lifelong learning in STEM.

3. Funding the Future

The OECD recently found that staff-student ratios in Irish higher education have deteriorated from 20:1 to 23:1 and continue to compare unfavourably to European peers, indicating that the capacity of the system to respond to emerging challenges and to cater to a growing student cohort is limited by continued underinvestment. Evidence from the UK[3] suggests that high student-staff ratios in STEM have a greater negative impact on student experiences and outcomes than in other disciplinary fields. This reflects that STEM fields of study often require more contact hours, as well as an academic workforce that carries out a diverse range of intensive roles across student support, laboratories, research and dissemination, practice-based learning, enterprise engagement, and societal outreach.

Funding the Future explicitly seeks to enhance the quality and international standing of our higher education system and a key part of that includes bringing staff-student ratios more in line with European peers. Addressing the core funding deficit would provide higher education institutions with greater capacity to strategically plan enhancements for STEM capacity and provide greater agility to respond to related skills need.

[3] Elif Kara, Mirco Tonin, and Michael Vlassopoulos (2021). Class size effects in higher education: Differences across STEM and non-STEM fields. Economics of Education Review. Volume 82, 102104, ISSN 0272-7757, https://doi.org/10.1016/j.econedurev.2021.102104.

The first instalment of the €307m funding requirement identified in Funding the Future was, at €40m, considerably less than that required to make any meaningful impact. It is essential that, in line with Funding the Future ambitions, the urgently needed investment of €307m is fully addressed over the next two budgets with at least €150m provided in Budget 2024. This would, among other benefits, support universities in sustaining core delivery across STEM, further strengthening and pursuing strategic development in these disciplines, and sustaining agility and good practice.

4. Capital Investment

STEM-related programmes by their nature tend to have higher capital investment requirements than many other areas as a result of additional facility and equipment needs. STEM covers a diverse range of disciplines and courses, each with particular resourcing needs, from specialist built and outdoor facilities, as well as equipment, ongoing materials costs, and a growing need for digital capacity. In addition, STEM facilities and equipment can become obsolete at a faster rate due to emerging technologies and approaches.

Furthermore because of such specialist needs there tends to be less capacity to absorb additional student numbers within existing facilities in comparison to other areas where dedicated laboratory space or access to specific equipment or facilities may not be required. As noted above IUA universities have absorbed a significant number of additional STEM enrolments over the period from 2015/16 to 2021/22 and the capacity to continue to expand student numbers in these areas is now being constrained by lack of capital infrastructure and equipment.

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.

5. Research and Innovation

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. Given the previously acknowledged difficulties in meeting the targets for increased postgraduate enrolments set out in Innovation 2020 and the ambitions now set out in Impact 2030, the importance of increased investment in researchers is critical. Without increased opportunities and visibility for research talent, championing STEM to young people and across all levels of education will be hampered. Furthermore, such coordinated actions across education can enhance evidence-based and research-informed teacher education for STEM.

The ongoing review of State Supports for PhD Researchers is an opportunity to consider the full progression of students from primary through to research. An estimated 9 in 10 PhD[4] graduates enter industry and professional occupations, cultivating skills and capacity for cutting-edge research between our universities and enterprise. 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[5] highlighting the need for high-level research experience for the knowledge economy.

6. Diversity and Inclusion

Institutional and disciplinary strategies for gender equality and inclusion have begun to close the gap between male and female student participation, however, as noted above greater coordination between second and third level is required to achieve parity. Encouraging women and marginalised cohorts to enter STEM courses or careers will rest on strengthening engaged citizenship, broadening understanding of what STEM entails, and improving career guidance to address perceptions of particular fields as masculine in nature. The IUA would encourage further focused EDI initiatives in STEM that can more deeply consider gender stereotyping and inequalities, holistically examining why

[4] Ireland's Higher Education Research System: A Review by the Higher Education Research Group (2021)
[5] Graduate Outcomes Survey - Postgraduate Research Graduates (GO 2021) | Statistics | Higher Education Authority (hea.ie)

some disciplines are dominated by one gender identity and the actions that can be taken to address this imbalance going forward.

Funding initiatives are very much welcome, including the €3.7million allocated by Ministers Harris and Foley in June 2022 to increase diversity and inclusion, as well as public understanding of STEM. Of the 47 projects funded, IUA universities are spearheading 28 of these, demonstrating the significant need to invest in our staff and students to champion such initiatives. Indeed, public understanding and awareness of STEM and increasing diversity in STEM go hand-in-hand, ensuring that women and marginalised groups are supported in their fields of expertise as role models.

The Maynooth University STEM Passport to Inclusion, which supports young working-class women to engage with STEM, is a key example of the potential of targeted initiatives. A post-programme participation survey that 79% of participants were considering a career in STEM, and 79% of students said they were now considering studying a STEM subject. The role of female champions and mentors was also of critical importance, with 95% of students indicating that mentors engaged with the project had changed their view of STEM.

The IUA strongly supports the recently published National Access Plan that recognises diversity and inclusion is not solely based on widening access, but also rests on ensuring that students from under-represented and marginalised backgrounds are supported to succeed and to achieve positive outcomes for further study and their career pathways. While HEA data indicates overall female participation in STEM courses stands at approximately 33%, this number is considerably higher across access routes, including HEAR and DARE, as well as in foundation courses.

7. Key Recommendations

- To increase capacity in higher education for enhanced STEM provision, as well as outreach and engagement activities, government must fulfil as a matter of urgency the €307million funding commitment under Funding the Future, with at least €150m to be provided in Budget 2024.
- A step change in Exchequer capital investment is required for higher education institutions to address the immediate capital investment needs of the sector and to meet planned demographic growth over the rest of this decade. Such an increase in funding would help to increase capacity across STEM disciplines and support essential digital transformation projects.
- A coordinated action plan that is inclusive of the significant role that higher education plays in meeting STEM skills needs is required cross-sectorally, through primary to tertiary. The plan for an integrated tertiary sector is an opportunity to achieve this aim.

- A broader strategy for lifelong learning, including re-skilling and up-skilling, is required to unlock the potential for STEM participation and inclusion across an individual's educational and careers journey.
- The new research agency should work proactively to increase funding for postgraduate research places across STEM disciplines.