How do we reach the target of 20 million ICT professionals by 2030?

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Executive Summary

The Digital Decade target of 20 million ICT specialists employed within the EU will only be met if new, additional measures are identified, accepted, funded and implemented as a matter of urgency. The magnitude of the challenge involved in achieving this goal has been widely recognised. In her 2022 State of the Union address, President von der Leyen identified 2023 as the 'Year of Skills' to heighten awareness and focus minds on the need for collective action.

In this document, the authors suggest an array of targeted implementation and policy actions that can be adopted by member states to address constraints in the ICT talent pipeline. Not every member state will be able, or indeed will wish to implement every policy outlined herein. It is recommended that each state undertake a **digital skills audit** that is benchmarked using accepted standards. Such an audit will inform the process whereby a roadmap for implementation that is correct for a particular member state can be determined.

However, some key factors affect the skills deficit facing every member state. **Gender constraints dominate**. Across the EU, insufficient numbers of girls and women are choosing to study and pursue a career in ICT.

A concerted effort is required across member states to increase fluency in using advanced digital technologies. More citizens need to spend, or be afforded, more time to improve their digital skills. There needs to be a renewed focus on this process being a journey rather than a destination. Upskilling needs to be more **competence rather than award based**.

Significant talent pipeline issues face every member state. The systemic challenge facing the EU is the need for more people with the appropriate skills for emerging job roles. Less than one-third of individuals have "above basic" digital skills, and overall, only 20% of EU enterprises provide digital training for their personnel. Employees at present do not have the right to request time within the working week to support their need to upskill or retrain. Given the recruitment challenges that obtain, it is imperative that enterprises invest time so that the EU skills base can pivot to meet the development opportunities that exist.

The authors suggest actions that, within the context of the five pillars of the EU Digital Competence Framework, should be prioritised if the EU is to maximise the possibility of delivering 20 million ICT professionals by 2030.

The recommendations made split broadly into seven different categories. The main report contains targeted actions within these categories. These recommendations address, among other things, measures to promote better gender diversity within the cohorts that pursue the STEM disciplines. How to promote a better understanding of ICT and STEM more generally, and to outline a range of practical steps to improve the take up of those subjects that are crucial to the development of sufficient numbers of ICT professionals at various points in the skills pyramid.

In summary, the Deans' group recommend distinct sets of actions:-

- → Increase the digital skills talent available to the EU through a focused strategy that addresses pinch points throughout the supply pipeline.

- → Expand the range and quality of digital skills education that is offered across Europe.

- → Proactively reduce the gender gaps that result from the primary and secondary school tiers of STEM education. Critically review the current curriculum and teaching practices failing to engage females in STEM-related subjects.

- → Encourage students who leave second-level education with a study destination outside the traditional digital disciplines to pursue skills pathways where they can gain greater competence in ICT subjects.

- → Provide support for an increased range and number of practical, workplace-based digital skills apprenticeships, often described as vocational, ICT education opportunities.

- → Recruit and train more teachers who will actively promote ICT skills in the primary and secondary tiers of education.

- → Encourage the implementation of a range of policy reforms at member state and commission levels to promote the enhanced education of digital skills.

The EU University representatives warmly welcome the significant expansion in funding for ICT skills education that has taken place recently and recognises the merits of the recent call for applications to create Master's and Bachelor's programmes in digital technologies. With this new call under the Digital Europe Programme, the Deans' group recognises the significant efforts being made to tackle the current shortage of ICT specialists and digital professionals, which is common to all Member States.

For these efforts to be successful, multi-annual funding envelopes are necessary so that the excellent talent that is necessary to deliver these innovative new programmes can be recruited and, most importantly, retained in the Higher Education sector.

Main Document

The European Union (EU) has struggled to keep pace with the new demands of the labour market in Information and Communication Technologies (ICT) for some time. In July 2019, the Digital Economy, Recovery and Skills Unit at the European Commission (DG CONNECT) convened the first in a series of six meetings with Deans' Group representatives from EU Universities offering specialised courses and programmes in advanced digital technologies, as per the mapping of the commission's Joint Research Centre (JRC), in an effort to formulate a co-ordinated response to increase the pool of talent in this space.

This document represents the resulting Deans' group response to the challenge issued by EU President von der Leyen in her 2021 State of the Union address to deliver a 'top-level' structured dialogue on digital education and skills. The particular focus of the Deans' group deliberations thus far has been to consider actions that will mitigate the **critical shortage of ICT specialists across the EU**. It is the Deans' view that this shortage is a key limiting constraint if the priority actions outlined in the *Digital Education Action Plan 2021-2027 (DEAP)* are to be achieved.

Adopting the roadmap outlined in Figure 1, the authors have summarised the contributions made in the various forum meetings thus far, and the wider Deans' group were afforded the opportunity to scan the document for omissions and/or additions that should be made during September 2022 before the release of the document for further consideration by the wider stakeholder audience.
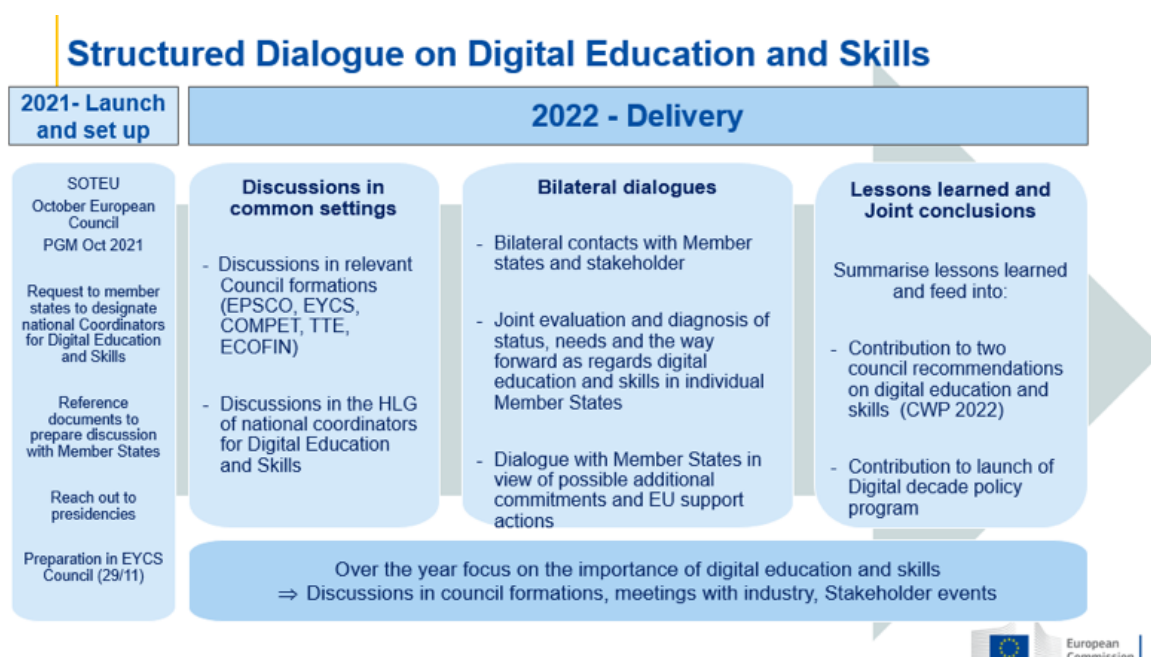

Figure 1: High Level view of the structured dialogue on digital education and skills process. Source: European Commision.

State of Play

All Member States of the European Union currently face a critical shortage of digital experts (DESI 2021), hampering the development, uptake and use of emerging key digital technologies. In 2020, 8.4 million persons worked as ICT specialists across the EU. The highest number was reported in Germany (1.9 million ICT specialists), followed by France (1.2 million), and their combined share accounted for less than 40% of the EU's ICT workforce. Cedefop predicts that more than three million new ICT professional and technical roles will be created by 2030. As Figure 2 illustrates, although these job opportunities will be spread right across the EU and represent a development

opportunity for every EU Citizen in every member state, as things stand, the Digital Decade target of 20 million ICT specialists employed within the EU **will not be met** unless new, additional measures are **identified, accepted, funded and implemented** as a matter of urgency.

The magnitude of this challenge has been widely recognised. In the 2022 state of the Union address, President von der Leyen identified 2023 as the 'Year of Skills' to heighten awareness and focus on the need for collective action.
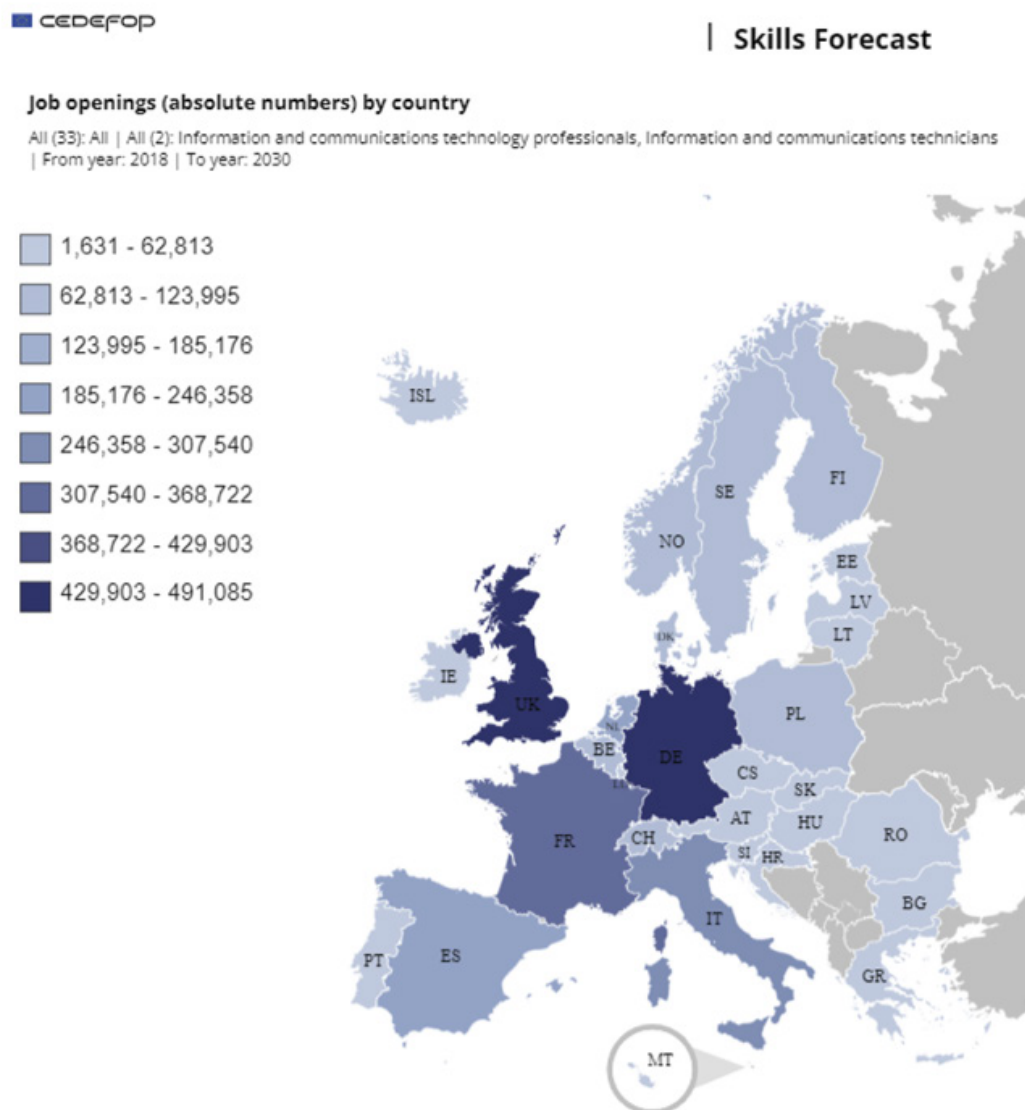

Figure 2: Net 2030 EU Job opportunity predictions in the ICT space.
Source: Cedefop

To successfully increase the numbers of ICT specialists, several key challenges have already been outlined by a variety of different authors:

- Insufficient numbers of girls and women are choosing to study and make a career in ICT;

- Difficulties experienced by a variety of socio-economic groups in gaining access to higher education, in particular to digital curricula. This includes, for example, a lack of scholarships or other financial support, lack of investment in the attractiveness of specialised digital courses, and insufficient opportunity to integrate digital skills training within an on-the-job experience.

- Lack of integration of advanced digital technologies (AI, data, cybersecurity) into the curricula of higher education courses outside of ICT programmes;

- Gaps in the provision of comprehensive, quality and inclusive adult learning systems that address barriers to participation;

- Lack of shorter courses with flexible modes of study (part-time, distance) in key digital technologies, leading to micro-credentials;

- Underinvestment in courses in advanced digital technologies, such as AI and cybersecurity, as well as investment in integrated competence centres, industries and universities that can deliver an ecosystem of excellence that can attract and retain talent;

- Inadequate labour market activation policy provision (and attendant programmes), which include a plan for continuous monitoring and evaluation of learning outcomes.

- Difficulties in attracting and retaining international talent with competence in digital skills.

Gender constraints dominate the above list of factors. It is the Deans' group view that the severe gender imbalance within the Digital skills talent pipeline, where only one in five ICT specialists and one in three STEM graduates are women, is the most significant. This constraint means that not only is the pool of available talent smaller than it should be, but that digital solutions are devised and deployed in a manner biased by gender. This structural deficit compounds other factors and is key to the shortage of fundamental and specialised education professionals capable of reskilling or upskilling the EU's workforce in key digital areas.

A concerted effort is required to increase fluency in using advanced digital technologies. Europe has a highly educated labour force, but many citizens do not devote sufficient time to develop the digital competence necessary to leverage the €4bn a day that Accenture has estimated as accessible within the EU digital ecosystem. 73% of businesses report that a lack of staff with adequate (digital) skills constitutes one of the main obstacles to investment. A recent report33 shows that around two-thirds of existing digital workers in the US (those who possess high-in demand technical skills, such as AI, machine learning, cloud, IT automation, and cybersecurity) moved into their current role from a different occupation.

These are hybrid profiles that combine digital skills related to advanced technologies and more traditional skills.

Other talent pipeline issues. The systemic challenge facing the EU is the lack of sufficient people with the appropriate skills for emerging job roles. Less than one-third of individuals have "above basic" digital skills and overall only 20% of EU enterprises provide digital training for their personnel. The leaders in this domain are Finland (38%) and Belgium (33%). Digital transformation has meant that a sizable portion of so-called 'middle-skill' level employment now requires the ability to use basic information technology tools, manage data, communicate effectively using an array of digital media channels and exhibit practical skills across a broad variety of tech platforms, including, among other things, health monitoring technology, computer numerical control equipment, enterprise management software, customer relationship management software, and data visualisation tools including spreadsheet and/or other dashboarding utilities.

Targets and objectives. The Digital Decade targets building a community of at least 20 million ICT specialists by 2030 who are employed in the EU, with an attendant gender convergence at all inputs to the talent pipeline. Year-on-year increases at the current rate of progression will lead to a projected ICT population of approximately 14 million, according to Cedefop, which represents a significant talent shortfall that needs to be urgently addressed if the EU is to retain its competitive position in the global economy.

Furthermore, in addition to requiring that 80% of the EU population will have basic digital skills, the Digital Decade has set out a roadmap that will lead to a digitally transformed ecosystem for European businesses and citizens by creating a secure and sustainable digital infrastructure.

This necessarily leads to a requirement for a resilient, flexible workforce capable of pivoting to new job roles, many of which have not been created yet.

Such a challenge requires the rapid development of a creative, problem-solving citizenry capable of exhibiting skills in the higher echelons of the EU Digital Competence framework (i.e., toward the right-hand side of Figure 3).

Figure 3: The Digital Competence Framework for citizens.
Source: EU

The authors suggest the following actions that, within the context of the five pillars of the Digital Competence Framework outlined in Figure 3, should be prioritised if the EU is to maximise the possibility of delivering 20 million ICT professionals by 2030.

1. Increase the digital skills talent available to the EU through a focused strategy that addresses pinch-points throughout the supply pipeline.

1.1 Promote a better understanding of the need to study the STEM disciplines:

An increased fluency in the use of digital technologies must be seen as a journey rather than a destination that will result in a greater ability to solve many different societal challenges and will ultimately lead to a better quality of life for all our citizens.

Options for implementation:

- Provide resources for improved storytelling about noteworthy upskilling journeys and interesting use cases.
- Fund the recruitment of individuals who will resonate with target groups as a voice of authority when it comes to the broadcast of these stories.
- Sponsor the development of targeted campaigns to communicate upskilling stories from under-represented groups in the digital / STEM disciplines.

1.2 Reframe career guidance in the latter years of second-level education to stimulate student interest in STEM subjects.

Options for implementation:

- Organisation of events dedicated to an increased participation in selected courses.
- Renewed focus on targeted promotion of these courses within under-represented groups (e.g., Women, Socio-economic, Regional) using trusted role models and influencers.
- Introduce targeted training for Guidance Counsellors so that they frame answers to the key questions that are asked by students when making career choices that are sympathetic to the Digital Skills agenda.
- Raise awareness of digital careers among secondary school students through targeted events, including game-based learning.
- Build a repository of stories from existing initiatives, such as "Les Cigales" at the Centre International de Rencontres Mathématiques – CIRM, which combines games and mathematics during a five-day session dedicated to high school girls or the "iWish" initiative that digital enterprises in Ireland have actively supported.

2. Expand the range and quality of digital skills education offered across Europe. The Deans group suggest a broad set of recommendations to inculcate principles of ICT excellence throughout the education system. By increasing the attractiveness of ICT courses in the EU, better ICT skills outcomes can be attained by a broader spectrum of citizens.

2.1. Incentivise Higher Education Institutions to devote more resources to ICT education.

Options for implementation:

→ Increase the 50% matched funding criteria for Digital Skills teaching programmes to at least 75% for qualifying Higher Education institutions.
→ The EU should encourage the recognition of EU- wide credit transfer to enable the delivery of ICT degrees by multiple partner institutions.
→ Funding calls should favour proposals that recognise learners arriving with credits gained from other HE/FET/international institutions via ICT short courses, micro-credentials or, indeed, longer qualifying programmes.

2.2. Provide support to improve the interoperability of universities' IT systems, enabling institutions to collaborate on the co-delivery of a European ICT Degree.

In the context of already existing networks, for example, University Alliance or consortia of technical universities and DIGITAL projects, the objective should be to enable students to access a broad portfolio of courses and learning materials.

Options for implementation:

→ The Commission should expand the range of pilot calls for university alliances to demonstrate their ability to co-operate to deliver high-quality Digital Education.
→ Member States should incentivise collaboration between Higher Education Institutions to facilitate the delivery of digital skills education.
→ Member states should incentivise the pooling of high-performance computing resources across higher education institutions. Member state borders should not impede accessing such resources.

2.3. Support universities to fund Professional ICT Education that is capable of delivering high-quality life-long learning opportunities, at scale, in digital skills areas.

This step is essential if the EU is to enable the effective upskilling and reskilling of the current workforce.

Options for implementation:

→ Expand funding schemes for the recruitment of new teaching resources for the delivery of Professional Education in Digital Skills.
→ Promote the use of relevant real-world challenges, in collaboration with industry, that will prompt citizens to embark on, and persist with, their digital upskilling journey.
→ Incentivise industry to provide time for its employees to avail of upskilling and reskilling opportunities in the Digital skills space.
→ Recognise excellence in the delivery of life-long learning Digital skills programmes.

2.4. Support new forms of cooperation between education institutions and other external organisations.

This may include businesses, research, digital innovation hubs, Fab Lab-type organisations, and any outlet where students can experiment by working (and playing!) with digital technologies.

Options for implementation:

- Expand funding for collaborative short courses and micro-credentials to deliver enhanced digital skills competencies.
- Set up shared European platforms for education in digital technology. The objective is to pool the skills and best practices across our European universities.
- Subsidise the incorporation and delivery of masterclasses delivered by expert industry practitioners in digital skills short courses.
- Support the introduction of creative problem-solving activities in digital skills short courses that are supported by and focus on industry use cases.
- Fund outreach programmes that encourage citizens to develop digital skills during leisure time.
- Build shared repositories of learning resources that facilitate the easy design of systems, the programming and integration of devices, the collection of data with sensors, the analysis of data with AI methods, the development of user-friendly interfaces, etc.
- Create a portfolio of use case stories that link experiences to professions and career development.
- Develop advice clinics for students so that they have clarity on what is required to become an expert in a particular profession or job role.

2.5. Encourage cooperation between different faculties to enable the inclusion of advanced digital skills, in particular ethics training, in the curricula of fields outside traditional ICT disciplines (e.g. medicine or law).

This will contribute to the mainstreaming of the latest digital technologies in all areas of the economy, empowering professionals to leverage the power of Digital Technologies in their daily work.

Options for implementation:

- Implement in full the adopted Council Recommendations on micro-credentials for lifelong learning and employability agreed by EU Member States on 16 June 2022.
- Provide sufficient funding support for properly integrating digital skills within non-ICT programmes.

- Design standalone modules that consider how the high-level expert group's recommendations on artificial intelligence (AI HLEG), with particular reference to deliverables pertaining to Ethics Guidelines for Trustworthy AI, may be included in non-ICT curricula.
- Develop a highly accessible range of micro-credentials (short courses) and other digital content that enhances the teaching of Tech for non-Tech specialists. The objective is to popularise the understanding of digital technologies and encourage further study.
- Support the development of transversal and inter-disciplinary problem-solving modules that bring students from different disciplines together to tackle real world sustainability challenges.
- Support the creation of recognised Continuous Professional Development (CPD) in the development of digital skills in non-ICT workplaces.
- Expand the EU digital badge system to recognise attainment of specific digital skills or transformation competences.

2.6. Increasing the number of professors, teaching staff and facilitators in the digital skills space.

Support top-ups for salaries and other incentives to attract teaching staff and technicians with excellent digital skills to join EU universities.

Options for implementation:

- Augment and extend the support already available through the DIGITAL programme. Establish dedicated schemes for the attraction of third country digital skills talents, using models proposed by, e.g., the European Research Council.
- Recognise the need for additional practitioners and other support staff like technicians, online moderators and teaching assistants to provide feedback quickly to students.
- Support the development of a range of 'Professor of practice' roles that will encourage industry practitioners to teach digital skills modules in EU universities.
- Establish a recognised/accredited EU carousel of masterclasses that will enable managers to develop, maintain and update their skills in small bitesize CPD chunks.

2.7. Increase PhD numbers in Digital technologies across the EU through proper funding mechanisms, increased cooperation with industry and also the mobilisation of private funding sources to support research

Options for implementation:

→ Recognise that PhD researchers require a stipend that is commensurate with the cost of living in the member state where the student will be based.
→ PhD stipends must be regularly reviewed to reflect changes in the cost of living in the member state where the student will be based.
→ Enhance and expand the range of industry placements that are on offer to ICT researchers in the digital skills space.

→ Introduce the principle of a project extension within DIGITAL or HORIZON programmes to facilitate 'No talent left behind' or Digital skills education that offers an extended window to build on IP developed within a project for translation or upskilling purposes.
→ Extend mobility grants and target an increased uptake of grants by under-represented groups.
→ Provide tax or R&D credits to industry who supply use case data sets and practitioner insight on the data for education purposes.
→ Introduce compensation schemes so that industry practitioners can devote more of their time to assist Higher Education institutions in the design and delivery of digital skills education that is more relevant to the future of work. Enterprises should be able to backfill staff easily so that support can be provided in a sustainable fashion by all stakeholders.

3. Provide better options for students who leave second-level education with a study destination that is not directly ICT related so that they can gain greater competence in ICT subjects.

Options for implementation

→ Promote the incorporation of STEM modules in early years of non-STEM programmes.
→ Introduce Data Analytics/Engineering modules (Collection, Labelling and Visualisation of data) across an increased number of third level programmes.
→ Increase the number and range of conversion courses that are on offer to graduates to facilitate a pivot toward job roles that require increased Digital skills competence.
→ Increase the number and range of programmes that are offered to enable workplace-based learners pivot toward roles in their enterprise that require increased digital skills competence.

3.1 Increase the availability of relevant community of practice supports to incentivise the study of digital disciplines with a particular focus on improving gender and socio-economic diversity in ICT.

Options for implementation

→ Increase the number and range of funding supports for the delivery of programmes in the digital skills space based on actual increases in numbers of students from under-represented groups.
→ Introduce new mechanisms for up-front payments to promote delivery of programmes to students from under-represented groups.
→ Provide travel, subsistence, equipment and mentoring support to promote workplace-based learning opportunities for students from under-represented groups.
→ Provide funds for the provision of targeted feedback on student output so that technical excellence is developed more quickly.
→ Resources should be provided so that 'at risk' digital skills students should be quickly identified and provided with extra tutorial assistance to enable student success.
→ Communities of practice should be established so that digital skills students can study effectively in moderated environments where they can develop their skills more quickly.

4. Provide support for an increased range and number of non-traditional further education opportunities including workplace based digital skills apprenticeships, practical or vocational ICT education pathways.

Options for implementation

- ⊕ Provide students with more opportunities to gain academic credit through reporting and/or critically reflecting on their workplace experience with real-life use cases.
- ⊕ Incentivise the development of activities that stress the importance of data driven or digitally transformed decision making, involving SMEs and larger companies.
- ⊕ Develop and promote a register of digital apprenticeship opportunities so that second level students know that they can immediately gain employment while they develop their digital skills.
- ⊕ Create non-traditional pathways to a professional ICT qualification that recognises and rewards aptitude for digital skills rather than the ability to do well in a terminal end of year examination.
- ⊕ Develop a fast-track process that enables students from outside the EU to apply for a workplace based educational opportunity in the digital disciplines.

5. Recruit and train more teachers who will actively promote ICT skills in the primary and secondary tiers of education.

Options for implementation

- ⊕ Fund the establishment of curriculum development panels where a balanced representation of women and men will design a STEM curriculum that will incorporate the use of digital technologies in a manner that has more widespread appeal among girls and boys.
- ⊕ Develop bursary schemes for teachers to develop their practical digital skills in a higher education or industry setting.
- ⊕ Provide equipment and training support for the development of exciting student projects in a stimulating community of practice environment.
- ⊕ Incorporate skills for inculcating creative problem solving and critical thinking in teacher training pedagogies.
- ⊕ Recognise innovation in Industry/academic and cross tertiary co-design and co-delivery.
- ⊕ Develop an EU 'teaching hero' scheme that recognises and rewards inspiring teachers of digital skills, particularly in under-represented socio-economic settings.

6. Proactively reduce the gender and diversity gaps present in all tiers of STEM education. Critically review the current curriculum and teaching practices that are failing to engage girls in STEM related subjects.

Options for implementation

- Fund retention initiatives to address the systemic phenomenon of students pivoting away from the digital disciplines more quickly than other more classical subjects.
- Reform curriculum and teaching practices that fail to engage girls in STEM subjects. Ensure that gender balance exists on the boards that are charged with digital skills curriculum development at all levels of education.
- Fund the dissemination of evidence of actions that have led to increasing number of female students in STEM programs. The EU should fund activities that create evidence about what different organizations have done, and what kind of impacts those activities have had.
- Promote research that creates evidence of how to increase the number of female students, and then share this evidence based knowledge for other organizations on how to create impactful campaigns that have actually increased the number of female students on particular programmes.
- Fund events aimed at raising women's awareness of digital tools and jobs. Priority may be given to initiatives targeting girls in secondary schools.
- Explore how separate but complementary cohorts made up of shorter FET/work based/ self-directed programmes can be combined with those from longer HE programmes to create more vibrant communities of practice.
- Sponsor activities that showcase the efforts of student organizations to advance digital skills, support diversity and create a social fabric for student expression in this space.
- Support storytelling by student organizations that have succeeded in creating more safe and inclusive spaces for the expression of Digital skills by female or international students.
- Proactively measure and then reward actions that reduce the gender gaps that exist in the teaching ranks for STEM subjects.
- Provide practical incentives (Equipment, mentoring and time off in lieu) for female teachers who wish to pivot toward the teaching of STEM subjects.
- Develop a subsidised upskilling pathway for women who wish to teach digital skills.
- Facilitate faster progression through the professional ranks for women who teach digital skills.
- Promote stories involving role model female teachers, particularly those who may have pivoted toward the teaching of digital skills from non-traditional backgrounds.
- Involve teacher training institutes and education science specialists from the design of a campaign to its deployment, in order to address the root causes of gender disparities within the education system.
- Celebrate non-traditional pathways into ICT, particularly those who have entered from apprenticeship and vocational backgrounds rather than the traditional academic entry routes.
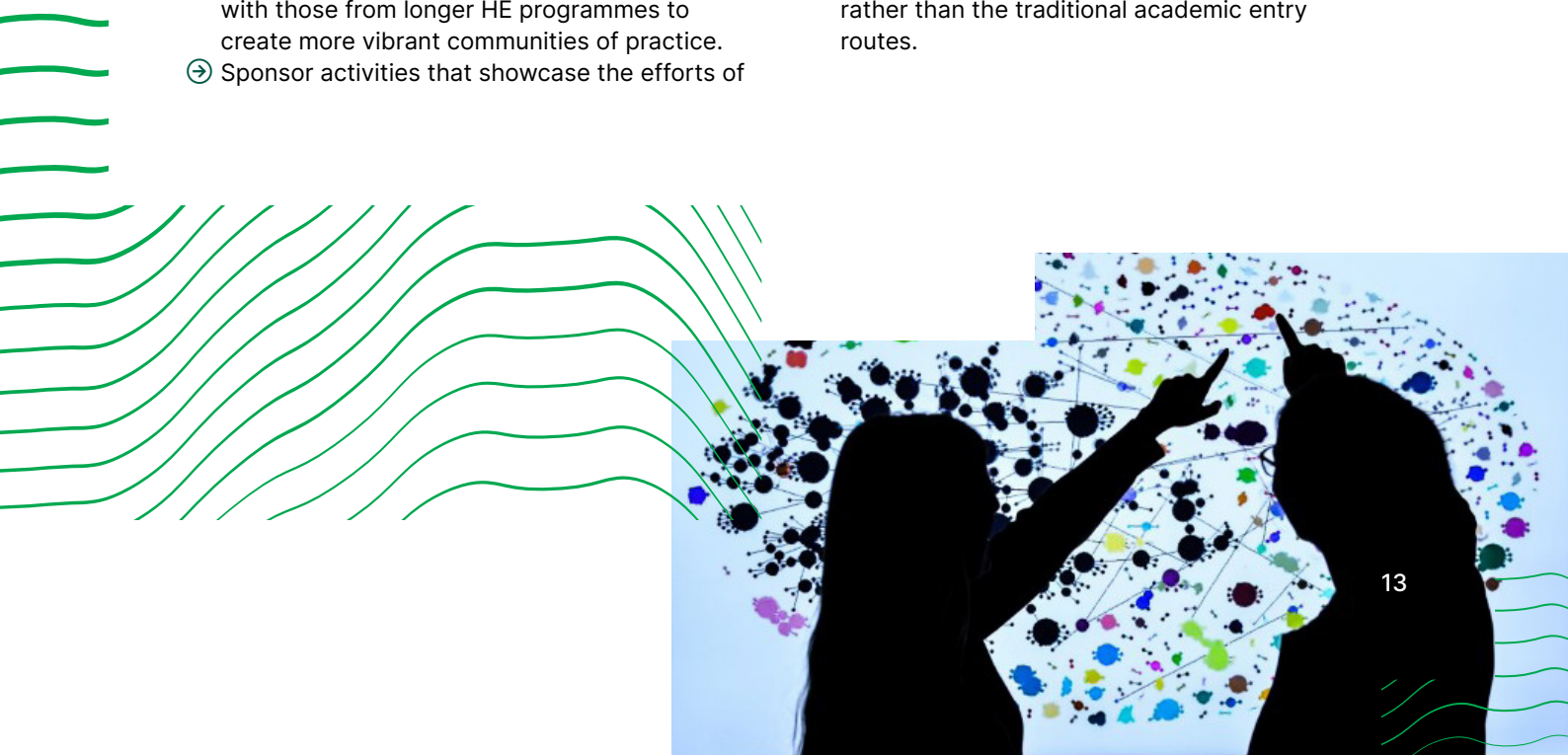
7. Encourage the implementation of a range of policy reforms at a member state and commission level to promote the enhanced education of digital skills.

The Deans' group makes the following recommendations for action to remove obstacles to pursuit of ICT skills and to increase cooperation between universities and industry so that the education on offer is relevant to the EU's societal needs.

7.1. Encourage Member States to facilitate upskilling and personal development for their citizens.

7.1.1. The right to learn throughout one's career should be enshrined through legislation, collective labour agreements or contracts of employment.

7.1.2. Member states and/or employers should embrace the principle that a certain amount of time in the working week be set aside for upskilling and personal development.

7.1.3. This principle should be a cornerstone of any discussions in relation to the implementation of a four day working week. The modalities of a 4+1 approach might be explored in this context.

7.1.4. According to the World Economic Forum, 50% of the global workforce is going to need to upskill or reskill in the coming years if they are to embrace new responsibilities stemming from an influx of automation. Member states should compensate businesses that provide staff protected time to engage with higher education institutions for the provision of digital skills education.

7.1.5. Promote an integrated approach to curriculum and assessment where digital competence is verified using particular modes of learning for specific curricular subject matter i.e., as an example consider the use of Jupyter Notebooks to illustrate the achievement of learning outcomes in Python over more traditional assessment modes.

7.2. Reduce barriers at national level that lead to capacity constraints for digital skills courses.

7.2.1. Any barriers that prevent the participation by businesses in EU Digital innovation hubs need to be highlighted and eliminated.

7.2.2. Support the design of flexible higher education programmes where credit recognition from multiple programmes and/or institutions has taken place.

7.2.3. Funding models in Higher Education should incentivise the creation of programmes that increase participation by students from non-STEM disciplines with Digital disciplines to give exposure to foundational Digital skills. (e.g statistics, mathematics, coding)

7.2.4. Enable Higher Education Institutions to recruit excellent teachers on flexible contracts for the delivery of Digital skills education and introduce targeted measures for the recruitment and retention of teaching professionals in the digital skills space.

7.2.5. Encourage collaboration between Higher Education institutions for the delivery of programmes where specialist expertise gaps may exist in particular branches of ICT, (e.g., AI, Machine Learning, Data Engineering, Cybersecurity, Ethics, etc.), due to the difficulty in recruiting excellent people to teach these subjects.

7.2.6. A specific focus on higher profile digital technologies which represent an opportunity due to their disruptive potential, (such as e.g., Blockchain or the Internet of Things), is required. This will necessitate resourcing by HEIs to provide training experts in these domains.

7.3. Encourage Member States to incentivise the recognition and accreditation of cross-border education programmes at national level.

7.3.1. Introduce personal learning credit incentives for strategically important digital disciplines to establish a culture of lifelong learning across member states.

7.3.2. Member States and the EU should provide combined support for the building of dedicated agreed transnational training programmes in targeted fields such as inter alia, Python, R, Data Analytics, Machine Learning, DORA or Blockchain

7.3.3. Measures should be introduced to streamline the accreditation process for programmes delivered by consortia of different universities.

7.3.4. Strengthen the portfolio of short-form or micro-credential courses that are offered to learners at all life stages and educational backgrounds to increase citizens' overall exposure to digital upskilling.

7.3.5. Incentivise the creation of courses that promote a multi-state community of practice through the use of moderated forums. Students should have access to experts from different EU states in such forums. This will facilitate a faster growth of deeper expertise across the digital disciplines.

7.3.6. Encourage collaboration between Higher Education institutions through incentivising the recognition of personal learning credits gained across multiple different institutions in multiple different EU states.

7.3.7. Establish a European process for the recognition of digital skills acquired outside traditional education to facilitate the employability of people who wish to retrain in digital professions.

7.4. Ensure the sustainability of digital skills programmes through incentivisation of their development across the spectrum of EU projects.

7.4.1. Enhance the Digital skills ecosystem at a national level by increasing funding across Digital skills pipelines, at primary, secondary, higher education and research.

7.4.2. Ensure sustainability in national education funding mechanisms by taking into account national requirements for sustainability KPIs for funding.

7.4.3. Increase the prominence of Digital upskilling, 'No talent left behind', and other engagement or training initiatives in Horizon Europe projects. Encourage all consortia to include an enhancement of digital skills component that is relevant to the deliverables from their proposal.

7.5. Update the roadmap of digital infrastructures supported by the EU (including the ESFRI roadmap) to incentivise contribution to the objectives of the Digital Education Action Plan.

7.5.1. Mobilise key digital infrastructures to commit to this European endeavour,

7.5.2. Facilitate access to cutting-edge technologies across the EU so that students and professionals enrolled in digital training programmes can hone their skills on state of the art platforms and systems.

7.6. Expand the infrastructure objectives of European funds managed by regions (mainly ERDF, ESF+, REACT-EU)

7.6.1. Broaden the scope of digital infrastructure projects to support awards for secondary and higher education institutions.

7.6.2. Enable access for students and teachers to the digital equipment funded by the Cohesion Policy and the Recovery Plan.