



Building competencies for digital and green innovation in higher education

The Education and Innovation Practice Community (EIPC)

This is the second in a series of three “Innovation Bulletins” on developing competencies to support innovation for the digital and green transitions. They are outputs of the **Education and Innovation Practice Community (EIPC)**, a European Commission initiative implemented with the OECD as part of the [New European Innovation Agenda](#), flagship 4 “Fostering, attracting and retaining deep tech talent”.

This Bulletin presents key lessons and inspiring examples of policy and practice on how traditional higher education programmes can best develop competencies important for green and digital innovation. It brings together key messages from related [analysis](#), case studies, and two international peer-learning events carried out as part of the EIPC activities.

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Higher education systems have a vital role to play in cultivating the competencies that tomorrow's innovators will need to navigate the digital and green transitions. These competencies include advanced technical skills, deep disciplinary knowledge and cross-cutting skills such as critical thinking and creativity. Evidence indicates that individuals with higher education are more likely to engage in innovative activities although much remains unknown about the specific mechanisms that drive this increased propensity to innovate (OECD, 2024^[1]). The correlation between higher education attainment and improved numeracy, literacy, and problem-solving skills in technology-rich environments is clear (OECD, 2019^[2]). At the same time, substantial differences in skill levels of higher education graduates across countries show that there is much to learn about how higher education builds competencies effectively.



I welcome this second Bulletin of the Education and Innovation Practice Community. It contains inspiring examples of innovative higher education curricula which have been elaborated through close collaboration between higher education institutions, businesses, and relevant educational bodies. They help learners become innovators equipped with the necessary skills and competencies to tackle the challenges and embrace the opportunities of the digital and green transition. *(Pia Ahrenkilde Hansen, Director-General of DG EAC, European Commission)*



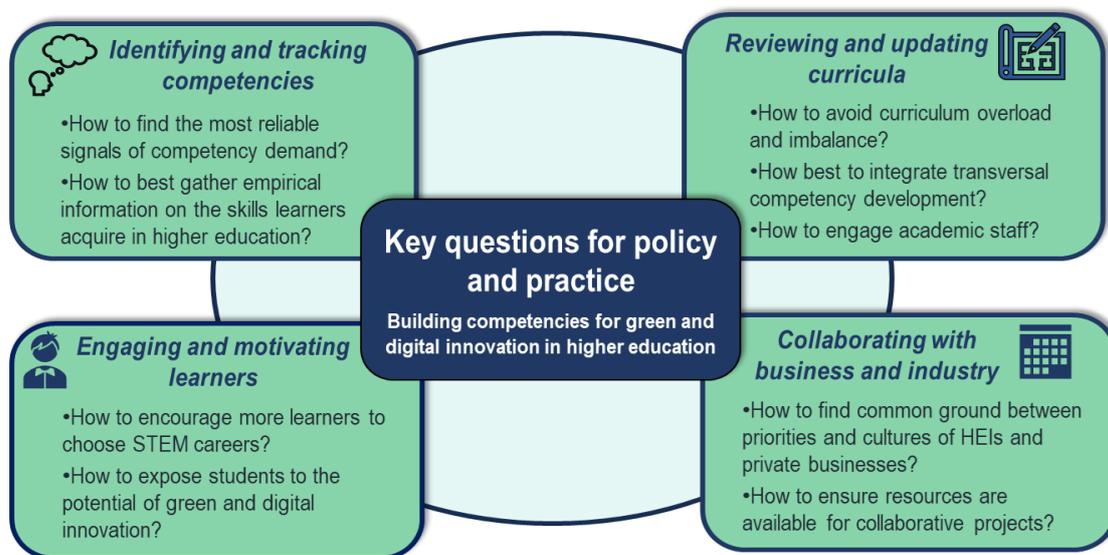
Approaches to promote competency development for green and digital innovation in higher education

There are several approaches that higher education institutions (HEIs) and governments can pursue to promote students’ competencies for innovation. Taking a coherent and systematic approach to **tracking demand for and supply of competencies** can help to identify the most important competencies for green and digital innovation and understand where key gaps in human capital lie. Regularly **reviewing and updating programme curricula** can help to ensure that the content of programmes remains fit-for-purpose as industries and societies evolve, and that curricula promote important transversal and discipline-specific competencies. **Engaging and motivating learners** to participate in programmes and experiences that are most likely to build their competencies for innovation is also key. Finally, promoting **fruitful partnerships with business and industry** can help to ensure higher education provision prepares students to engage in and develop innovative processes.

Each of these approaches for action raises **tough questions for policy makers and practitioners** and presents a range of implementation challenges (Figure 1). Getting clear signals about which competencies are needed in society is a perennial challenge, whether the signals are generated from quantitative methods, surveys, or from expert consensus. Moreover, in the most advanced fields, the **needs for specific competencies are continuously evolving** as new technologies and processes come on stream. Higher education systems may not always receive actionable information from skills anticipation systems and may be slow to respond – **updating degree curricula is a lengthy and resource-intensive process**, which requires a careful balance between relevance, depth and learning load. Academic staff also need to be engaged and motivated to update curricula, in the face of often limited incentives to do so.

Competencies in science, technology, engineering, and mathematics (STEM) are vital for technological innovation. However, **engaging students in STEM subjects presents significant challenges**, as evidenced by the lack of substantial growth in shares of STEM graduates in recent years. HEIs and schools could work better together to build foundational competencies and enthusiasm for science and technology from an early age (OECD, 2023[3]). Involving private sector business and industry can also help ensure that higher education provision builds the most relevant competencies for innovation ecosystems. **Collaborations with the private sector need to be mutually beneficial**, balancing the short-term commercial needs of businesses and the longer-term focus of HEIs on a wide range of learning outcomes.

Figure 1. Building competencies for green and digital innovation: key questions for policy and practice



Source: OECD analysis of key policy and practice challenges related to building competencies for green and digital innovation in higher education (OECD, 2024[1]).

Higher education institutions must do more than just react to present industry needs. They should proactively anticipate and shape the competencies of the future. This forward-thinking approach is essential for closing the education-innovation gap and equipping students to thrive in an ever-evolving global landscape. (*Andreas Schleicher, Director of Education and Skills, OECD*)



Creating favourable conditions for policy and practice: key EIPC messages

In 2024, the EIPC identified promising policy and practice strategies through an analytical report (OECD, 2024^[1]), case studies, and two international online events held on 11 January (titled “Cultivating the next generation of green and digital innovators – the critical role of mainstream higher education”, with 220 participants) and 29 February (an international peer-learning workshop with Finland, with 170 participants, see Spotlight box). Key take-aways – also summarised in Figure 2 – are:

Strategies for anticipating and assessing emerging competency needs:

1. **Systemic, multidimensional frameworks can be valuable for anticipating competency needs** by employing a variety of quantitative and qualitative methods to monitor competency demands, from forecasting models to expert committees (ILO/ OECD, 2018^[4]). For example, Finland's use of the VATTAGE and MITENNA forecasting models, complemented by stakeholder consultations (CEDEFOP, 2022^[5]) serve as the basis for Finland's strategy to expand tertiary attainment in the context of digital and green transitions (Finnish Government, 2021^[6]).
2. **It is worth investing in advanced quantitative methodologies** like machine learning for analysing online job postings and curriculum content. These approaches show promise in complementing traditional practices, although their effectiveness relies crucially on the use of high-quality, fine-grained data and robust methodologies. For example, Biasi and Ma (2022^[7]) use natural language processing to examine HEI course syllabi and research literature to shed light on the potential drivers of the "education-innovation gap," – the ratio of similarities between a course's content and recent knowledge from research (Biasi and Ma, 2022^[7]).
3. **Efforts are needed to advance the development of assessments** of technical and transversal competencies essential for innovation. The DCU Futures project in Ireland exemplifies efforts to build and evaluate transversal competencies (DCU Futures, 2024^[8]). It aims to radically redesign undergraduate education by introducing new programmes focused on transversal competencies and developing a framework for their assessment, resulting in a personalised skills profile.

Strategies for effectively reviewing and updating HEI curricula:

1. **Public authorities can play a role in encouraging collaboration between HEIs and industry on specific advanced disciplines.** For example, the University of Cyprus¹ has developed a master's degree in Artificial Intelligence through a collaboration framework established among four European universities (University of Cyprus, 2022^[9]). Similarly, the recently developed Master's programme in Quantum Computing at the University of Barcelona was created in collaboration with the Catalonian Quantum Technologies Hub (QuantumCat) enhancing its relevance to industry and ensuring that the programme design incorporates the necessary expertise (University of Barcelona, 2024^[10]).

¹ Note by the Republic of Türkiye The information in this document with reference to “Cyprus” relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Türkiye recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Türkiye shall preserve its position concerning the “Cyprus issue”.

Note by all the European Union Member States of the OECD and the European Union The Republic of Cyprus is recognised by all members of the United Nations with the exception of Türkiye. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

2. **System-level policies can be used to create incentives and supports for academic staff to align curricula with the knowledge frontier, engage in pedagogical innovation and collaborate across disciplines.** Potential policy initiatives include national teaching awards, sabbaticals to update knowledge and access to tools and training opportunities that support effective instructional design. Additionally, targeted funding mechanisms for interdisciplinary projects and platforms to facilitate cross-disciplinary collaboration could be further developed.

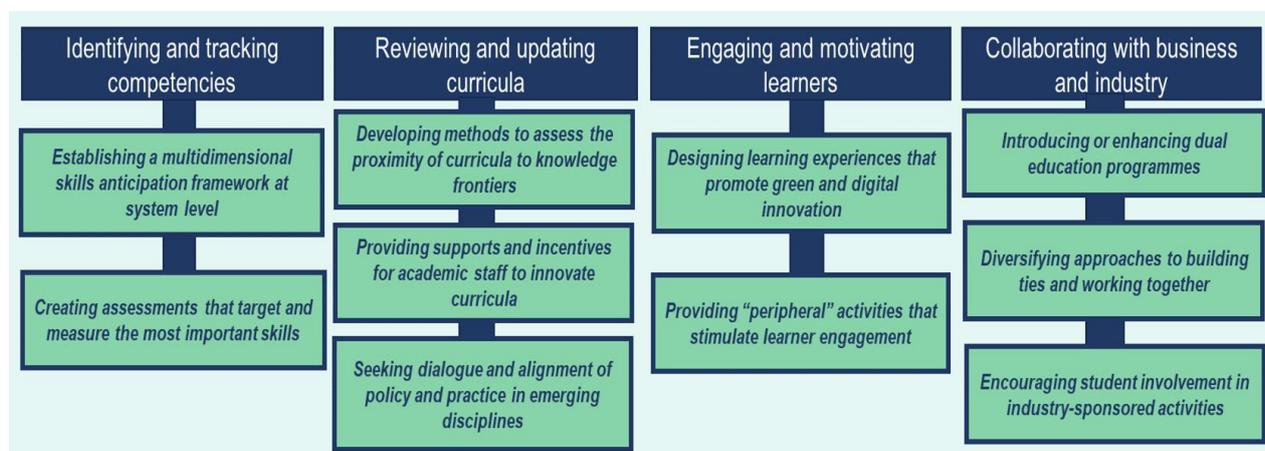
Strategies to effectively engage students:

1. **Institutions and academics need to design engaging educational experiences** that focus on green and digital innovation and foster awareness and motivation among students. Such approaches have been implemented within Malta College of Arts, Science and Technology ICT Student Apprenticeships (MCAST, 2022^[11]), for example. Specifically, students engage in an extended apprenticeship in the digital sector, integrating real-world industry experience with their academic studies. Similarly, at KU Leuven, the Transdisciplinary Insights Honours Programme (KU Leuven, 2024) immerses students in an innovative, interdisciplinary course aimed at addressing global challenges, building research and entrepreneurship skills through teamwork.
2. **Access to "peripheral" experiences** can stimulate learners' engagement. Traditional HEIs, especially those with large campuses, can offer immersive environments that extend beyond traditional classroom settings. For instance, exploiting the campus as a "living lab" for experiential learning could help cultivate skills for green and digital innovation (Zen, 2017^[12]).

Strategies for mutually beneficial HEI-business and industry collaboration:

1. **Introducing or strengthening dual education models**, such as industrial PhDs or degree apprenticeships, appears to be a promising approach to develop innovative graduates. The EIT Manufacturing Doctoral School, backed by the European Institute of Innovation and Technology (EIT), is a notable example of efforts to help manufacturing PhD students to commercialise their research (EIT Manufacturing Doctoral School, 2024^[13]), thereby supporting career advancement and stimulating innovation.
2. **Encouraging students to participate in industry-led or sponsored innovation activities**, such as hackathons, workshops and contests, can add considerable value. Such activities allow students to apply academic knowledge in real-world scenarios, enhance their professional skills and establish contacts in innovative industries. An example is the Airbus' "Fly Your Ideas" competition, which invites students to tackle aerospace challenges, linking their academic studies directly with industry innovation (Airbus, 2024^[14]).

Figure 2. Cultivating competencies for green and digital innovation: options for policy and practice



Source: OECD analysis on building competencies for green and digital innovation in higher education (OECD, 2024^[11]).

Spotlight: Key lessons from the EIPC international peer-learning workshop with Finland

In February 2024 the OECD hosted an online international peer learning workshop with the Finnish Ministry of Education and Culture to reflect on the strategies and challenges faced by policymakers seeking to expand the supply of competencies needed to drive innovation for the digital and green transitions. Peers from Austria, Canada, Ireland and Portugal contributed to the discussion.

Finland is advancing two strategies in its higher education system that aim to address challenges and harness opportunities presented by the green and digital transitions. The first involves **widening attainment** by increasing the number of higher education graduates, thereby increasing the overall supply of advanced skills for innovation. By 2030, the strategy aims to ensure that at least 50% of young adults in Finland have successfully completed a higher education degree (Finnish Government, 2021^[6]).



Finland seeks to raise attainment by prioritising first-time students, addressing backlogs, and focusing on fields with high labour demand and geographic areas with highest demand for study places. Strategic profiling and collaboration among higher education institutions, together with targeted funding for each institution's strategic actions and cooperation, are key to this strategy (*Sirkku Linna, Director-General, Department for Higher Education and Science Policy, Ministry of Education and Culture, Finland*)

Finland's second strategy seeks to **democratise** – or widen – the reach of higher education, on the basis that everyone will need new knowledge and skills for the digital and green transition. Central to this goal is the Digivisio 2030 initiative, a national digital service platform that enhances the interoperability of digital and open education services and offers a wide range of digital resources for learners. It is designed to enhance flexible learning opportunities by promoting collaboration between HEIs. The initiative seeks to extend the reach of higher education, making it more accessible to diverse populations (Nordlund and Piironen, 2022^[15]; Digivisio, 2024^[16]).

A critical aspect of systemic change is establishing trust and ensuring that all HEIs are ready to embrace new technologies and methodologies. Considering the diverse readiness levels and the informational needs of learners is essential for the success of large-scale educational transformation (*Hanna Nordlund, Programme Director, Digivisio, Finland*)



Key lessons from the workshop were the need for:

- **Integrated student-centric and data-driven policymaking:** the event highlighted the importance of involving students and drawing on data in policymaking. Student perspectives are vital for the creation of inclusive higher education policies, while data on participation patterns, skills demand or graduate outcomes can help ensure policies are well targeted.



Student engagement is crucial for developing inclusive and effective higher education policies, ensuring decisions reflect student needs (...). A data-driven approach, exemplified by Ireland's deprivation index, is key to informing these policies. (*Mariana Reis-Efinda, Senior Manager for Access Policy, Higher Education Authority, Ireland*)

- **Supporting institutional autonomy within a framework:** The conversation highlighted the importance of HEIs having the flexibility to innovate and adapt to local needs with their efforts recognised within structured performance frameworks. Such frameworks, defined by strategic objectives or measurable indicators, can help ensure that institutions align with broader, national educational goals and standards, fostering accountability and quality in higher education programmes.
- **Championing pedagogical innovation:** Speakers pointed out the need to innovate teaching methods in step with the broadening of access to higher education. The diversification of student populations, including students with a wider range of educational backgrounds and international students, requires more personalised and inclusive approaches to teaching.

Strategies to diversify Portugal's higher education offerings have expanded access, but also introduced challenges, such as the need for more personalised approaches. Addressing these challenges through pedagogical innovation is essential to support student success and reduce drop-out rates. (*Joaquim Mourato, Director-General, Directorate-General for Higher Education, Portugal*)



- **Mapping the needs of – and building trust among – different stakeholders:** The event highlighted the dual need to align stakeholder interests and foster trust within the higher education ecosystem. Speakers emphasised the critical role of identifying shared objectives among educational institutions, students and employers to develop an adaptive educational system. The conversation highlighted establishing trust among all stakeholders in higher education as a critical prerequisite for embracing new technologies and methodologies.



By focusing on those education providers ready to engage now, we tap into early adopters to accelerate our digital and educational initiatives, creating a ripple effect that propels our system towards a more adaptive, future-ready economy and sets the stage for widespread adoption and transformative change. (*Robert Luke, Chief Executive Officer, eCampusOntario, Canada*)

- **Addressing implementation challenges through targeted and tailored initiatives:** The discussion highlighted the “implementation gap” for many strategic goals and targets – such as improving student-teacher ratios and promoting gender balance in STEM programmes. To bridge this gap, targeted initiatives focusing on specific actions like developing a STEM action plan to boost female participation, addressing teacher shortages and offering tailored support for non-traditional students, were advocated over broader and less focused efforts. The conversation also underscored the importance of leveraging the showcase value of educational institutions that are early adopters of innovative technologies and pedagogies.

Efforts to ensure barrier-free access in higher education include strategies like outreach programmes, a digital collaboration platform, a STEM action plan for women, and initiatives addressing teacher shortages and lifelong learning support. (*Helga Posset, Policy Officer, Federal Ministry of Education, Science and Research, Austria*)



Note: This information is derived from the presentations and discussions at the online international peer learning workshop on [‘Building competencies for green and digital innovation through higher education’](#) held on 29 February 2024.

About this Innovation Bulletin

This document was authored by Gillian Golden and Nikolaj Broberg, analysts in the OECD Higher Education Policy Team at the OECD Directorate for Education and Skills. Simon Roy (Team Leader, Higher Education Policy) advised the development of the document. Editorial and publication support were provided by Marika Prince and Eda Cabbar. Overall guidance was provided by Paulo Santiago (Head of Division, Policy Advice and Implementation, OECD Directorate for Education and Skills) and Andreas Schleicher (Director, OECD Directorate for Education and Skills).

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This Education Spotlight has been authorised by Andreas Schleicher, Director of the Directorate for Education and Skills, OECD.

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