



Education and innovation for the digital and green transitions: How higher education can support teachers and school leaders

The Education and Innovation Practice Community (EIPC)

This is the first in a series of four analytical reports prepared by the OECD Higher Education Policy Team on developing competencies in support of innovation for the digital and green transitions. These reports support knowledge exchange within an **Education and Innovation Practice Community (EIPC)**. EIPC is an action of the European Commission (DG EAC), implemented with the OECD under the [New European Innovation Agenda](#), flagship 4 “Fostering, attracting and retaining deep tech talent”.

This analytical report examines how higher education institutions (HEIs) can support teachers and school leaders in secondary education to help their students to develop competencies for innovation, drawing on research evidence and policy and practice examples from a wide range of education systems. It offers five options for consideration by education policy makers to strengthen HEIs’ role in supporting schools to develop human capacity for innovation:

1. Develop and include **specific requirements on research, digital and green competencies** into teacher professional standards, and support their integration in teacher-education curricula.
2. Support HEIs and schools to **establish structured partnerships** to jointly design, deliver and evaluate initial teacher education programmes that are anchored in pedagogical practice and research.
3. Support the **professional development of teacher educators** to enhance the quality and relevance of teaching and learning offered in initial teacher education.
4. Mobilise HEIs to develop diverse and flexible **upskilling and reskilling opportunities** on digital and climate change education, and incentivise research engagement among teachers.
5. Engage experts from higher education in **school self-evaluation and external quality assurance** to build the capacity of school leaders and teachers to develop competencies for innovation.

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1. Introduction

The impact of climate change on our economies and societies and growing digital divides – exacerbated by the global COVID-19 pandemic – have reinforced the urgency of policy action to achieve a fair and just transition to a digital and climate neutral economy (OECD, 2023^[1]). To ensure that the twin digital and green transitions occur in as fair and just a manner as possible, education systems must prepare citizens for the changes required and to use digital technologies as enablers of change (Muench et al., 2022^[1]). By establishing an Education and Innovation Practice Community (EIPC), the European Commission and OECD have joined forces to foster international collaboration around higher education’s role in developing talent for innovation in secondary and higher education, as well as adult upskilling and reskilling. EIPC is a flagship initiative under the European Union’s (EU) “New European Innovation Agenda” (European Commission, 2022^[8]), and seeks to develop talent for innovation in support of the digital and green transitions, and “deep-tech” innovation.¹

Building competencies to support innovation for the digital and green transitions in schools

School education must ensure that students develop competencies that will enable them to shape, and adapt to, the social and economic innovations needed for the digital and green transitions. Analysis by Broberg (2023^[4]) and the *OECD Skills Outlook 2023* (OECD, 2023^[10]) suggests that a wide range of competencies can support innovation for the digital and green transitions, although it is challenging to establish direct links between particular competencies and specific types of innovation. In this report, “competencies for innovation” is used to refer to a broad set of knowledge, skills, attitudes and values acknowledged in the research literature and various competency frameworks as essential for living and working in greening and digitalising economies (see Box 1).

Box 1. Foundational competencies to live and work in greening and digitalising economies

Based on a comparative analysis carried out by Broberg (2023^[6]) of the knowledge, skills, attitudes and values included in different competence frameworks – both comprehensive frameworks (e.g. Education 2030 Learning Compass (OECD, 2019^[13])) and frameworks with a specific focus on digital or climate change education (e.g. DigComp (Vuorikari, Kluzer and Punie, 2022^[10]), GreenComp (Bianchi, Pisiotis and Cabrera Giraldez, 2022^[11])) – the following set of competencies can be regarded as crucial for living and working in greening and digitalising economies:

- **Knowledge:** strong foundations in science and an understanding of how these subjects link to innovation and sustainability. Key knowledge domains include biology, physics and chemistry, as well as climate change and digital literacy.
- **Skills:** social, digital and transversal cognitive skills to live and work effectively in a global and highly interconnected 21st century society. A distinction can be made between basic digital skills (e.g. proficiency in information and communication technology (ICT), and data literacy); behavioural, social and emotional skills (e.g. communication, collaboration); and higher order cognitive skills (e.g. creativity, problem solving, systems thinking, critical thinking, research skills, metacognition, digital cognition).
- **Attitudes and values:** positive values and attitudes towards the environment (e.g. empathy, openness to change) and digital citizenship (e.g. digital etiquette, online behavioural norms).

Source: Adapted from Broberg (2023^[6]), “Understanding the competencies needed for innovation in greening and digitalising economies: Insights from existing literature”, *OECD Education Working Papers*, OECD Publishing, Paris (forthcoming).

Higher education can support teachers and school leaders to develop knowledge and pedagogies in support of competencies for innovation

This report examines higher education's role in supporting teachers and school leaders to upskill and reskill for the digital and green transitions. School educators are recognised as “the single most important school variable influencing student achievement” (OECD, 2005, p. 2^[21]). The initial and continuing education of teachers and school leaders is one of the two major “connection points” or mechanisms – alongside curriculum development – through which higher education has traditionally engaged with schools (Walsh and Backe, 2013^[15]; RCUK, 2020^[16]; OECD, 2022^[17]; Reimers M. and Marmolejo, 2021^[18]).² To help school leaders and teachers to re-think what and how they teach, HEIs themselves will need to re-think how they design and deliver teacher education. In most education systems, it is HEIs who design the content of initial and continuing teacher education programmes (Musset, 2010^[12]; OECD, 2022^[13]), which means that many of the challenges school educators face to teach competencies for innovation are the result of how they are being prepared and supported by HEIs.

To help governments across OECD and EU jurisdictions strengthen higher education's role in promoting effective school curricula, this report offers a review of the research literature as well as policy and practice examples of higher education-school collaboration in support of competencies for innovation. The primary focus is on examples that can help students develop climate change literacy and digital competencies, as this supports the work of EIPC (which focuses on developing talent for the digital and green transitions, and deep-teach innovation). The report draws on an extensive review of the scientific literature, expert interviews, and inputs from the EIPC network. The desk-based literature review informed the identification of inspiring policy and practice examples of higher education-school collaboration, and the establishment of a growing EIPC network (see Annex 1). Through an international online knowledge exchange event, the OECD team has convened the EIPC network to collaboratively develop key messages on higher education support for effective school curricula (see Annex 2), which have informed this report.

2. What are key challenges facing school educators to support the development of competencies for innovation?

This section discusses the readiness of teachers and school leaders to support the development of competencies for innovation. It does so by reviewing available evidence on teachers' pedagogical skills, as well as on the integration of different competencies for innovation in teacher-education curricula.

To help students develop competencies for innovation, it is crucial for teachers and school leaders to adopt pedagogies and practices in support of innovation competence development. Teachers need to develop lesson plans, teaching and assessment practices that support the progressive and equitable development of competencies for innovation among all learners. School leaders need to create conducive environments for student and their teachers to collaborate across subjects and grades, including with local community actors such as businesses, local government and parents. Drawing primarily on evidence from the OECD's Programme for International Student Assessment (PISA) and the Teaching and Learning International Survey (TALIS), the following sections review available evidence on how prepared and supported teachers and school leaders feel to teach competencies for innovation.

Teachers need support to develop knowledge and pedagogies that can help students acquire competencies for innovation

In the background report for the latest International Summit on the Teaching Profession – which took place on 12 April 2023 and convened education ministers, union leaders and other teacher leaders from high-performing and rapidly improving education systems to discuss the state of global education – the OECD underlined that the global challenges of social inequality, rapid digitalisation and climate change have raised our expectations of what teachers should know and be able to do:

We expect teachers to have a deep and broad understanding of what they teach, whom they teach and how students learn [...] to be great instructors, coaches, mentors and designers of effective and innovative learning environments, as well as technology experts and data scientists [...] to be experts in their field with up to date and hands-on industry skills and knowledge [...] to be passionate, compassionate and thoughtful [...] to respond effectively to students of different needs, backgrounds and languages [...] That is a lot of expectations. No wonder many teachers might feel daunted by the tasks before them (OECD, 2023, p. 16^[55]).

The ever-expanding list of expectations has made teaching perhaps one of the most challenging jobs in the world, which is reflected in high burn-out and drop-out rates among teachers. A representative survey of well-being among school leaders and teachers in the **United States** found that, in January 2022 (in the final phase of the COVID-19 pandemic), 85% of school leaders and 73% of teachers reported frequent work-related stress, compared with 35% of the general population of working adults, and are more likely to report feeling burned out (Steiner et al., 2022, p. 5^[56]). Further evidence collected by Eurydice across 31 jurisdictions in **Europe** identified shortages in initial teacher education in nineteen school education systems³ and high drop-out rates among novice teachers in ten systems⁴ (Eurydice/EACEA/EC, 2021, p. 34^[57]). Recognising the challenging nature of teaching, and to increase the overall attractiveness of the profession, some OECD and EU jurisdictions introduced measures to improve teachers' working conditions (including salary increases). In **Germany**, for example, where teacher shortages are a major challenge (OECD, 2022^[58]), the Standing Conference of Ministers of Education and Cultural Affairs of the Länder and the federal government adopted a package of measures to create better conditions for teachers in March 2023. Some of these include salary increases, enhancing initial teacher education and opportunities for continuing professional learning, as well as facilitating entry into the teaching profession for professionals from other sectors (KMK, 2023^[59]).

Investments in teachers' competence development have increased in some OECD systems

In some OECD and EU jurisdictions the increased expectations on teachers have been accompanied by investments in teacher education, with the aim of better preparing and supporting teachers as professionals in classroom settings (OECD, 2023, p. 16_[55]). Teacher education covers two dimensions: initial teacher education (ITE) and continuing professional learning (CPL). ITE encompasses the selection and attraction of prospective teachers to the profession; equipping prospective teachers with relevant competencies and ensuring the quality of ITE; certifying and hiring new teachers; and supporting teachers at the start of their career (OECD, 2019_[22]). CPL includes “all formal and informal activities aimed at helping teachers to update, develop and broaden their skills, knowledge and expertise” (OECD, 2021, p. 4_[60]).

Over the past 15 years, the requirements for ITE have increased in many OECD education systems. One of the drivers of this trend has been evidence that suggests that longer ITE has positive effects on student outcomes, as teachers are better prepared. Four years was identified as the most frequent duration of ITE programmes among participating jurisdictions with high performance in PISA (OECD, 2018, p. 46_[61]). Another reason for longer ITE is to discourage (young) people with poor qualifications from entering the teaching profession and raise the status of teaching as a high-profile occupation (OECD, 2019_[22]). Teachers also increasingly engage in CPL, with governments introducing incentives and rewards to stimulate take-up, other than making professional learning mandatory. In 2018, more than 90% of teachers participating in the OECD's TALIS survey reported that they had attended at least one continuous professional development activity in the year prior to the survey (OECD, 2020_[62]). Half of OECD countries with mandatory CPL for teachers also set a minimum duration for CPL, ranging from 20 hours every two years in the Slovak Republic to five days per year in Slovenia (OECD, 2022_[58]). The type of training attended by teachers also varies. Most teachers participating in TALIS 2018 (76%) reported that their professional development consisted of attending in person courses or seminars. Only 44% said that they engaged in training based on peer learning and networking which, as will be discussed later in this report, the research literature correlates with greater impact on enhancing student learning (OECD, 2020_[62]).

But teachers generally feel insufficiently prepared to effectively engage with and use research, or to teach digital competencies and climate change literacy

Looking at teachers' readiness to support students' digital competencies, TALIS 2018 data show that, on average across the 31 OECD jurisdictions participating in the survey, less than 43% of lower secondary education teachers felt well or very well prepared to use ICT for teaching when they completed their initial teacher education (OECD, 2020, p. 129_[62]). The complexity of climate change is also challenging for many teachers. A survey of school educators carried out by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) found that 40% of teachers are confident in teaching the cognitive dimensions of climate change (e.g. explaining the severity of climate change) and only about one-fifth feel well prepared to explain how to take action to tackle climate change (e.g. how to reduce humanity's carbon footprint). Almost one in three teachers said that they were unfamiliar with suitable pedagogies to support the development of climate change literacy among their learners (UNESCO, 2021, p. 6_[63]). These findings are confirmed in a recent meta-analysis of 169 independent studies on the effectiveness of environmental education, covering five decades of research into environmental education spanning 43 countries across the globe. While the evidence emerging from the studies reviewed was able to demonstrate that environmental education programmes can have a positive impact on developing students' environmental knowledge, attitudes, intentions and behaviour, it did not find any conclusive evidence on which type(s) of activities or pedagogies (e.g. traditional classroom activities, camps, field trips), have the biggest impact on student learning (van de Wetering et al., 2022_[25]). These findings suggest that more research is needed to identify those pedagogies which are most effective at stimulating students' climate change literacy, and to support teachers to adopt these pedagogies.

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To support their students to develop competencies for innovation, teachers will often need to refine the design of their educational activities by drawing on findings from educational research. However, many teachers feel insufficiently prepared and supported to engage with research in the field of education and the discipline(s) they teach. Evidence from an OECD policy survey among 37 Ministries of Education from 29 OECD countries – conducted from June to September 2021 – found that only 55% of respondent systems agreed or strongly agreed that practitioners in school education had the skills and capacity to understand and interpret educational research. A further 40% agreed or strongly agreed that educational practitioners were able to translate and apply educational research to solve problems in their context; and 30% agreed or strongly agreed they could co-design or co-conduct research with academics (OECD, 2023, p. 66^[64]).

TALIS 2018 data also shows that only 49% of lower secondary teachers, on average across participating OECD systems, felt well or very well prepared to teach cross-curricular skills such as “creativity, critical thinking and problem solving” (OECD, 2020, pp. 73, 129^[62]). This is confirmed in the OECD’s Curriculum Content Mapping exercise (CCM), which found the lowest rates of perceived preparedness to teach cross-curricular skills among teachers from Finland, France and Japan (25% and below) (OECD, 2022, p. 63^[23]). A schoolteacher survey conducted by the **United States** National Assessment of Educational Progress (NAEP) found that while 81% of 8th grade teachers nationally reported that they place “quite a bit” or “a lot” of emphasis on problem solving, only 39% of teachers reported putting “a lot” of emphasis on deductive reasoning, a key component of critical thinking (Bouygues, 2022^[65]). These findings suggest that supporting teachers to develop pedagogies and educational resources that support competencies for innovation will be a key priority for the future. A particular emphasis should be on strengthening teachers’ research competencies.

School leaders face constraints in building and sustaining a ‘school climate’ that is conducive to the development of competencies for innovation

As part of strategies to improve student learning outcomes, the international research literature underlines the importance of school leaders promoting a culture of professional learning, collaboration and innovation among schoolteachers, learners, parents and the wider school community (Elmore, 2004^[67]; Richards and Wheatley, 2022^[68]; OECD, 2023^[64]). Understood like this, effective school leadership empowers all actors that play a role in student learning – including learners themselves – to “actively contribut[e] to the design, implementation and sustainability of powerful, innovative learning environments [...] through distributed, connected activity and relationships [...] exercised at different levels of the overall learning system” (OECD, 2013, p. 20^[66]). To support the development of such school cultures, it is crucial for school leaders to build capacity for inquiry, self-evaluation and data analysis to identify both learners’ support needs and teachers’ professional learning needs, and to understand how to identify and scale innovative pedagogies that can positively impact student learning. Investing in the continuing professional learning of school leaders – in addition to that of teachers – will therefore be a key priority for OECD and EU education systems. However, evidence shows that in eleven out of 34 OECD systems and partner countries with available data, heads of schools offering general education programmes are not required to engage in any professional learning at all (OECD, 2022, p. 394^[58]). Higher education can play an essential role in closing this gap.

3. How are higher education institutions preparing and supporting teachers and school leaders to develop competencies for innovation?

This section discusses five mechanisms through which higher education institutions can support teachers and school leaders to help their students develop competencies for innovation. For each mechanism, the report reviews evidence on the impact of the support mechanism in question, key challenges facing HEIs in scaling and strengthening the impact of their support for schools, and how public policy is supporting institutional good practice.

HEIs support teachers and school leaders through five key mechanisms

Table 1 provides an overview and description of the different mechanisms through which higher education institutions support school educators to foster competencies for innovation among their students. The classification of mechanisms builds on analytical frameworks developed by the OECD for policy analysis in the areas of initial teacher education (OECD, 2019^[22]) and continuing professional learning (Boeskens, Nusche and Yurita, 2020^[226]; OECD, 2021^[60]).

Table 1. Overview of higher education support mechanisms for teachers and school leaders

Mechanism	Description	Objective
<i>Preparing prospective educators to teach competencies in support of innovation</i>		
1) Integration of competencies for innovation into teacher education curricula	HEIs integrate competencies for innovation – notably, digital, green and research competence development – in their ITE curricula to ensure they reflect competencies included in school curricula, as well as society.	School educators develop research competencies and pedagogies that support the development of digital and green competencies
2) Joint design, delivery and evaluation of initial teacher education	HEIs establish partnerships with schools to jointly design, deliver, evaluate and improve initial teacher education programmes, thereby ensuring that teachers' initial education is embedded in professional practice.	Initial teacher education is embedded in professional practice of schools
3) Professional development of teacher educators	HEIs support the professional development of teacher educators, notably: their capacity to engage in research and develop digital and green competencies.	Teacher educators draw on scientific research and have access to professional development opportunities
<i>Supporting the continuing professional learning of teachers and school leaders</i>		
4) Upskilling and reskilling of teachers and school leaders	HEIs offer upskilling and reskilling opportunities for school leaders and teachers, ranging from more formal micro-credentials and degree programmes to less formal opportunities for peer learning and research engagement in communities of practice and collaborative research projects.	School educators upskill and reskill for the digital and green transitions, and stay up to date with the latest research and innovations in the discipline(s) they teach
5) Build capacity for inquiry, self-evaluation and data analysis	HEIs support schools to build their capacity for inquiry, self-evaluation and data analysis to identify areas for improvement as well as innovation worth scaling or disseminating more widely across the institution.	Schools have the capacity to engage in critical, open and collaborative inquiry, self-evaluation and data analysis to inform pedagogical innovation

Source: The categorisation of higher education support mechanisms to prepare school leaders and teachers for innovation builds on analytical frameworks developed by the OECD for policy analysis in the areas of initial teacher education (OECD, 2019^[22]) and continuing professional learning (Boeskens, Nusche and Yurita, 2020^[226]; OECD, 2021^[60]). They have been adapted based on a desk-based review of policies and practices across the EU and OECD member countries, expert interviews and an online international knowledge exchange of the EIPC Network on 11 May 2023, focused on higher education to prepare school leaders and teachers for the digital and green transitions.

Preparing prospective educators to teach competencies in support of innovation

This section discusses the first three mechanisms introduced above, through which HEIs are developing their initial teacher education offerings to foster competencies for innovation: 1) the integration of competencies for innovation into initial teacher education curricula; 2) the joint design, delivery and evaluation of ITE with schools; and 3) the professional development of teacher educators.

Mechanism 1: Integrating competencies for innovation into initial teacher education curricula

Since the 1980s, responsibility for initial teacher education has increasingly been transferred from specialist teacher education colleges to institutions of higher education in OECD jurisdictions (Musset, 2010^[227]). Today, HEIs are responsible for designing the curriculum of ITE programmes in 36 OECD jurisdictions, and in nine they are also involved in setting content frameworks, accreditation, evaluation and/or providing advice and recommendation (OECD, 2022, p. 374^[58]). While there is not yet a commonly accepted and agreed list of “key ingredients of initial teacher education” (OECD, 2023, p. 21^[55]), policymakers, experts and practitioners agree that ITE should find a balance between developing subject-specific and practical knowledge on the one hand and pedagogical know-how on the other hand (OECD, 2019^[22]; Eurydice/EACEA/EC, 2021^[57]). International evidence also underlines the importance of teachers being capable of engaging with research in the field of education, as well as scientific developments in the subject(s) they teach (i.e. research literacy) and of applying this research in practice (i.e. research use) (OECD, 2023, pp. 66-7^[64]).

Evidence suggests that competencies for innovation – specifically: research, digital and green competencies – are integrated into teacher-education curricula to a limited extent

Evidence from 36 OECD and partner countries with available data shows that research skills development is often not mandatory for prospective teachers. In 12 jurisdictions,⁵ institutions are free to decide whether and how they offer research skills development to student-teachers. In **Japan**, research skills development is a voluntary course for student-teachers and in **Denmark** and **Mexico** it is not offered as a separate course at all – although in Denmark research skills development is part of the learning objectives for the bachelor project (OECD, 2022, p. 370^[58]). Interviews conducted with teacher educators revealed that research competence is also often developed as part of a separate project or module (e.g. a final dissertation), rather than integrated across ITE curricula. For example, the University of Barcelona in **Spain** develops and assesses student-teachers’ research competence through a 5 ECTS-credit final project, as part of which students are required to develop a teaching innovation proposal (University of Barcelona, n.d.^[228]). Similarly, the University of Vienna’s master’s programme on teacher education (**Austria**) includes a module on applied research and requires students to complete a master’s dissertation (University of Vienna, n.d.^[229]). Developing students’ research competence as part of a separate module rather than in each subject entails the risk that student-teachers and teacher educators view research competence as an “add on” rather than a crucial foundation of teacher education and the teaching profession in general.

Several teacher educators and higher education experts interviewed for this report explained that digital competencies are integrated more strongly into ITE curricula than green competencies. One of the main reasons for this, they argue, is that in many school education systems, digital competencies have been integrated into school curricula for much longer than green competencies. The COVID-19 pandemic has also directed policy action towards developing students’ and teachers’ digital competencies. As a result, education for sustainable development (ESD) is mostly integrated as an elective course into ITE curricula. This is confirmed by Tasiopoulou et al. (2022^[69]) and Evans (2019^[230]), who find that ESD is mostly integrated on a project basis, most often into geography and science courses. For example, ESD is an optional course in Stockholm University’s master’s programme in education in **Sweden** (Stockholm University, 2023^[231]). “Supporting sustainable thinking” was only introduced in 2021 as an optional module into the ITE programme of Tallinn University in **Estonia** (EIPC webinar, 11 May 2023).

Integrating competencies for innovation into teacher professional standards

To support the integration of research, digital and green competencies into teacher education curricula, several education systems have developed professional standards to “establish expectations at the system level” and “inform individual beliefs about what it means to be a professional educator and approaches to professional learning” (OECD, 2021, p. 13_[60]). Many of these emphasise teacher agency, enquiry, action research and collaboration as key competencies for graduate teachers (as will be discussed later, this has been shown to be an important element in continuing professional learning). The **Australian** Professional Standards for Teachers, for example, were developed by the Australian Institute for Teaching and School Leadership (AITSL) and seek to “guide the preparation, support and development of teachers” (AITSL, 2018, p. 3_[232]). Scotland (United Kingdom) and Ireland have professional standards that include an explicit focus on digital and green competencies. **Scotland’s** professional standards for teachers embed Learning for Sustainability and Digital Literacy across all standards (GTC, 2021_[234]). In **Ireland**, all HEIs offering ITE must obtain accreditation from the Teaching Council and meet seven standards. Three of these directly relate to the competencies for innovation presented in Box 1 (Teaching Council Ireland, 2020, p. 14_[233]):

Global Citizenship Education: to include Education for Sustainable Development; Well-being (personal and community); Social Justice, Interculturalism. There should be demonstrable integration between Inclusive Education and Global Citizenship Education rooted in the principle of care for others.

Creativity and Reflective practice: to include fostering a creative mindset among student-teachers, teachers as reflective practitioners; teachers as innovators; teachers as researchers; teachers’ relationship with the school as a learning community and the development of Taisce [i.e. non-governmental organisation] to support the process of portfolio-based learning.

Digital Skills: to include Digital Literacy; the use of digital technologies to support teaching, learning and assessment for all learners; the integration of digital skills across the programme including opportunities for student-teachers to explore new and emerging technologies.

Several competency frameworks have been developed to support HEIs and government agencies with the task of supporting the further integration of research, digital and green competencies into initial teacher education. Two digital competence frameworks for school educators developed in the European context are SELFIE (European Commission, n.d._[234]) and DigCompEdu (Redecker, 2017_[235]) (for an overview of digital education frameworks, see Volungevičienė et al. (2021_[236]) and Staring et al. (2022_[237])). An example of a framework that focuses specifically on how to integrate ESD into initial teacher education is the **Austrian** KOM-BiNE framework (Rauch and Steiner, 2013_[238]) (for an overview of ESD frameworks, see Mulà and Tillbury (2023, pp. 26-7_[239])). Researchers from four universities of applied sciences in the **Netherlands** have developed a framework that provides an overview of the level of research competence graduate teachers should acquire (Rozendaal et al., 2023_[240]). Further research is needed to compare and identify the knowledge, skills, and attitudes and values included in the many frameworks that exist currently to identify common domains. Table 2 provides an example of how different competence frameworks can be combined to generate an overview of teacher competencies to be developed in ITE.

To date, these guidelines and frameworks seem to have had little impact on the practice of teacher education institutions (Volungevičienė et al., 2021_[236]; Mulà and Tilbury, 2023, p. 26_[239]). One of the main reasons is that their use by HEIs is not mandatory, and it is difficult for governments and HEIs to choose which frameworks are most relevant to their context. Volungevičienė et al. (2021, p. 5_[236]) suggest that when using competency frameworks, governments and HEIs should “pick and mix” those frameworks that fit their national or institutional context best, and use them as a tool for self-reflection and quality enhancement. To strengthen quality and consistency across ITE programmes, a government-appointed Teacher Education Expert Panel in **Australia** has recently published a report that recommends establishing “core content” for all ITE programmes and mandating its inclusion in ITE programmes through accreditation, guidance and support mechanisms (Teacher Education Expert Panel, 2023_[44]).

Table 2. What are key competencies to be strengthened in teacher education programmes?

Competence	Framework	Description	Knowledge, skills and attitudes/values
Research competence	Reference framework on research competence of teacher educators (Rozendaal et al., 2023 ^[240])	The framework provides a breakdown of how ITE curricula should develop prospective teachers' inquiry-as-stance, which is "a form of professional learning in which professional learners start by investigating what is going on for their pupils and formulating hypotheses about how their practice may be impacting on the situation for these pupils. On this basis, they can then research and experiment ways to test the hypotheses they have developed" (OECD, 2021, p. 33 ^[60]).	Helps teachers to... <ul style="list-style-type: none"> • Identify gaps in (actionable) knowledge of educational practice • Conduct research to collect and analyse relevant literature to address the missing knowledge • Use methodological rigour to answer research questions • Apply research results in professional activity
Education for digital competence development (EDD)	DigCompEdu (Redecker, 2017 ^[235])	DigCompEdu was developed by the European Commission's Joint Research Centre and covers 22 competencies across six areas. One of these is teachers' capacity to facilitate learners' digital competence, which lists five key areas of focus (Redecker, 2017, p. 23 ^[235]).	Helps teachers to support learners'... <ul style="list-style-type: none"> • Information and media literacy • Digital communication and collaboration • Digital content creation • Responsible use of digital technology • Digital problem solving
Education for sustainable development (ESD)	KOM-BiNE framework for the integration of ESD in teacher education (Rauch and Steiner, 2013 ^[238])	KOM-BiNE was developed as part of a large scale EU project involving 15 teacher education institutions from eight European countries. The framework is divided into four main areas: knowing and acting; valuing and feeling; communicating and reflecting; and visioning, planning, organising and networking.	Helps teachers to... <ul style="list-style-type: none"> • Envision future/alternative scenarios • Contextualise, work and live with complexity • Think critically • Make decisions • Participate and act for change • Clarify values to learners • Collaborate across disciplines • Manage emotions and concerns

Sources: Adapted from Rozendaal et al. (2023^[240]), "Onderzoekend vermogen van startbekwame leraren: wanneer is het goed genoeg? Ontwerp van een referentiekader voor curriculumontwikkelaars" [Research competence of prospective teachers: when is it good enough? A reference framework for curriculum developers], *Tijdschrift voor lerarenopleiders Velon [Velon Journal for Teacher Educators]* 44 (1), https://hbo-kennisbank.nl/details/sharekit_hr:oai:surfsharekit.nl:d16ae9d3-2963-4172-b5fd-5fb0e1345830; (Redecker, 2017^[235]), *European framework for the digital competence of educators: DigCompEdu*, Publications Office of the European Union, Luxembourg, <https://op.europa.eu/en/publication-detail/-/publication/fcc33b68-d581-11e7-a5b9-01aa75ed71a1/language-en>; Rauch and Steiner (2013^[238]), "Competences for education for sustainable development in teacher education", *CEPS Journal* 3 (1), pp. 9-24, https://www.pedocs.de/volltexte/2013/7663/pdf/cepsj_20013_1_Rauch_Steiner_Competences_for_education_for_sustainable_development.pdf.

Mechanism 2: Joint design, delivery, and evaluation of initial teacher education

Changing only the curriculum or the *content* of ITE programmes – which includes linking it to the latest developments in scientific research – is unlikely to help teachers develop the skills needed to teach competencies for innovation (Révai and Guerriero, 2017, p. 65^[47]). To ensure ITE prepares teachers for effective classroom teaching, it is important for ITE to also be *structurally anchored* in the professional practice of schools. In addition to offering student-teachers opportunities to develop practical experience with teaching competencies for innovation (through practical experience in schools), it is important for ITE programmes to be designed, delivered and reviewed in close partnership with practitioners from school education. An OECD review of ITE systems in six OECD jurisdictions (Australia, Japan, Korea, Netherlands, Norway and the United States) found that many "ITE providers in general, and teacher educators specifically, do not have established communication channels and mechanisms to keep up with recent school policies such as school curriculum reforms" (OECD, 2019, p. 81^[22]). The study underlines the importance of moving ITE-school partnerships from ad hoc conversations on teacher placements to structural partnerships in which higher education and school practitioners jointly design, deliver, evaluate and improve the teacher education programme as equal partners, with school-based practitioners learning from student-teachers and academics about state-of-the-art pedagogical approaches, and scientists building on school practice.

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The study (OECD, 2019, p. 141_[22]) identifies five levels of collaboration ITE and schools:

- **No partnerships:** ad hoc conversations between partners.
- **Basic partnerships:** regular discussions on operational issues like candidate placement locations.
- **Collaborative partnerships:** structured meetings that involve sharing of data and ad hoc improvement strategies.
- **Continuously improving partnerships:** partners have joint projects and use a continuous improvement cycle.
- **Structural partnerships:** partners collaborate for the design, delivery, evaluation and improvement of coherent ITE programmes.

Evidence shows that concurrent teacher education programmes can be an effective mechanism to develop HE-school partnerships and enhance quality in schools and ITE

Concurrent teacher education programmes can be an effective way to establish structured partnerships between schools and teacher education institutions. This can ensure that initial teacher education is closely connected to educational practice and, vice-versa, that school educators are connected to the latest developments in disciplinary and pedagogical research. In concurrent programmes, pedagogical and practical training are offered at the same time as courses in the academic subject matter. They differ from consecutive teacher education programmes, where pedagogical and practical training follow a degree in the subject matter (OECD, 2019, p. 77_[22]). Concurrent programmes recognise ITE “as a system”, with many other stakeholders other than professional staff working in higher education responsible for the preparation of new teachers (including school leaders, teachers, as well as parents and students). The OECD’s 2022 edition of *Education at a Glance* found that concurrent models exist in 27 out of 36 OECD and other countries with available data, and consecutive models exist in 22 systems. While most countries only use one model, 13 countries reported using both. The type of ITE programme also depends on the level of education for which teachers are being prepared. Concurrent models are most common for the preparation of pre-primary, primary and lower secondary (general subject) teachers; consecutive models are most common for the preparation of upper secondary school teachers (OECD, 2022_[58]).

Concurrent programmes recognise ITE “as a system”, with many other stakeholders other than professional staff working in higher education responsible for the preparation of new teachers.

The closer involvement of schools in the delivery of initial teacher education puts greater expectations on the schools offering placements for trainee teachers and requires professional development for school leaders and teachers. The Arctic University of Norway’s concurrent master’s programme in teacher education includes targeted incentives and supports for the participating schools (offering practical placements to student-teachers) to become “university schools” (see Box 2).

Box 2. “University schools” pilot in Tromsø, Norway

In 2007, the University of Tromsø (*Universitetet i Tromsø* – UiT) and Tromsø University of Applied Sciences (*Høgskolen i Tromsø* – HiTø) merged to become the Arctic University of Norway (UiT). The merger incentivised professional staff from the teacher education institutions at UiT and HiTø to collaborate for the development of a new ITE programme in which educational theory, practice and disciplinary research are closely interconnected.

The project started in 2011 and involved piloting a five-year concurrent master's programme in teacher education (the first of its kind in Norway at the time) in collaboration with schools in and around Tromsø. The programme required student-teachers to immerse themselves in the subject content to a much greater extent and engage in practical training across all five years of the programme. This substantively increased the role of schools in the delivery of the programme. They were expected to meet a number of criteria to become “university schools” and were also offered support to develop their professional practice. For example, the school supervisors of student-teachers had to have a master's degree and follow professional competencies courses. The university also offered schools with access to networks and peer learning. Teacher educators and student-teachers were expected to use the university schools as an arena for applied research, in collaboration with teachers and students in the university schools.

Source: Arctic University of Norway (2021^[242]), *Universitetsskoleprosjektet i Tromsø (USPIT) [University schools project in Tromsø]*, https://uit.no/prosjekter/prosjekt?p_document_id=288271.

Giving HEIs a mandate to establish structured partnerships with schools

In some jurisdictions, public authorities are supporting HEIs – and within those, teacher education institutions– to establish structured partnerships with schools. One example is the *School-University Partnerships Initiative* (SUPI) in the **United Kingdom** (NCCPE, 2017^[213]), which ran between 2013-17 and was led by the National Co-ordinating Centre for Public Engagement (NCCPE). As part of the project, 12 universities in the UK received financial and implementation support to establish research partnerships with primary and secondary schools. Building on the “university schools” pilot in Tromsø (see Box 2), **Norway's** Centre for Professional Learning in Teacher Education (ProTed) has been offering financial support to teacher education institutions across the country since 2020 to establish structural partnerships with schools (ProTed, 2023^[243]). In the **Netherlands**, the Ministry of Education, Culture and Science has been supporting HEIs to establish “Regional HE-School Clusters” since 2004. Today, 28 HEIs and close to 360 primary and secondary schools collaborate as part of seven collaborative clusters. In 2018, the network jointly defined strategic priorities for the network to work on between 2018 and 2023 (HE-School Clusters, 2018^[244]). One of these is for schools and HEIs to collaborate on tackling teacher shortages, in collaboration with research and industry partners. An example is Food Valley (the regional HE-school cluster led by the University of Wageningen), which runs the “Educate Together” project (*Samen Opleiden*). As part of this initiative, teacher educators from Wageningen University meet with teachers, school leaders and students on a regular basis to examine the content of the teacher-education curriculum and ensure it aligns with the curricula of partner schools. The school and university partners also involve each other in professional development activities, and there is strong involvement of the school supervisors in the evaluation of student-teachers (Wageningen University, 2023^[245]). In **Sweden**, the government started a major national pilot project in 2021 (involving 25 HEIs) to develop and test sustainable collaboration models between academia and the school system in the areas of research, teacher education and school activities. The goal is to establish a sustainable, long-term collaboration model between HEIs and schools and thereby strengthen the disciplinary foundation of school education (Government of Sweden, 2021^[252]).

Mechanism 3: Supporting the professional development of teacher educators

In addition to reforming the content and structure of ITE programmes, teacher educators need access to opportunities and incentives for engaging in professional development. This is important because teacher educators in many higher education systems overlap with the research community and have not all had practical experience teaching in school-level education (Révai and Guerriero, 2017^[47]; OECD, 2019^[18]). They can also differ significantly from one another in terms of their qualification level, area of specialisation, work experience, contractual arrangements and institutional settings and, therefore, their readiness to prepare prospective teachers for their future job (Deketelaere et al., 2018^[246]).

Professional development of teacher educators is gaining importance

It is becoming more common for HEIs in OECD and EU jurisdictions to adopt institutional strategies aimed at building the pedagogical skills of academic staff engaged in teaching (including teacher educators). These strategies are often based on professional standards for teaching and learning. In some systems, HEIs have collaborated to develop nationally-shared teaching standards for HE staff, such as in **Denmark** or the **Netherlands** (VSNU, 2008^[247]; Universities Denmark, 2021^[248]). Individual faculties within institutions are often required to develop their own teaching and learning plans based on institution-level and (where they exist) national standards. For teacher-education institutions, this means developing specific standards for the professional development of teacher educators. For example, Cambridge University in the **United Kingdom** has developed a framework listing the competencies required of teacher educators at different stages in their career. The framework distinguishes between three career stages (i.e. teacher to trainer, autonomous teacher trainer, lead trainer) and three areas of knowledge (i.e. knowledge of teaching, knowledge of training, knowledge of teacher development) (Cambridge University, 2023^[249]).

To help academic staff (including teacher educators) meet professional standards, HEIs have started to set up dedicated teaching and learning centres. These centres aim to support academic staff to improve and professionalise their practice through a variety of activities, including guidelines, teaching materials, training courses, individual counselling or peer learning communities and the provision of prizes and awards (Staring et al., 2022, pp. 45-6^[237]; OECD, 2023, p. 103^[250]). HEIs in **Australia**, **Ireland**, **New Zealand**, the **United Kingdom** and the **United States** are frontrunners in the development of teaching and learning centres, and they are also becoming increasingly common in **European countries**. The European University Association (EUA) found that HEIs in 14 European countries (out of 28 surveyed) were regularly organising professional development for their teaching staff, typically through a teaching and learning centre (Zhang, 2022, p. 36^[251]). Depending on the higher education system and institution, teacher educators sometimes have access to specific professional development, in addition to support aimed at academic staff across disciplines (see Box 3).

Box 3. Professional development for teacher educators

The COVID-19 pandemic required many HEIs across OECD and EU jurisdictions to provide specific support for academic staff to enhance their digital competencies. For example, during the pandemic the ICT Research Centre at Károli Gáspár University of the Reformed Church in **Hungary** expanded its activities from conducting research and offering technical support on digital technology use towards organising training on digital pedagogy for staff across the institution (Dringó-Horváth, T. Nagy and Weber, 2022^[252]). The green transition is also pushing institutions to provide specific support to strengthen knowledge of climate change among academic staff. For example, the University of California, Irvine (UCI) in the **United States** offers a “Sustainability Fundamentals Training” for UCI staff (UCI, 2023^[253]).

Some HEIs offer specific professional development courses for teacher educators. For example, Arizona State University in the **United States** runs a course aimed at “creating, presenting, and evaluating effective teacher training workshops” (Arizona State University, 2023^[254]). In the **Flemish Community of Belgium** and the **Netherlands**, teacher educators from different HEIs have each established an inter-institutional “Association of, for and by Teacher Educators” (*Vereniging van, voor en door lerarenopleiders*). Both associations collaborate to disseminate teacher education research and inspiring practices through a quarterly teacher education magazine, webinars and peer learning events (VELOV, n.d.^[255]; VELON, n.d.^[256]).

Engaging teacher educators in professional development and research can be challenging

There is no internationally comparable data on the extent to which teacher educators engage in professional development (OECD, 2023^[209]; OECD, 2023^[254]). Experts interviewed for this report mentioned lack of time and incentives to engage in professional learning (which is often not mandatory), as well as limited connection to professional practice as some of the main reasons for the low take-up of professional development opportunities by teacher educators. A survey conducted by the EU found that only 37% of higher education institutions make certain courses compulsory for academic staff (Gaebel et al., 2018^[257]). Prizes and awards, as well as the introduction of specific competency requirements (e.g. digital competencies) in staff recruitment and performance appraisals, are ways in which HEIs are trying to incentivise staff participation in professional learning (Gaebel et al., 2018^[257]; OECD, 2023^[250]). While they often do not specifically target teacher educators, prizes and awards tend to attract staff with expertise in educational research and might therefore be an effective mechanism to incentivise the professional development of teacher educators. Stockholm University in **Sweden** and the University of Graz in **Austria** are two examples of HEIs that offer awards for good teaching (Stockholm University, 2023^[258]; TU Graz, 2023^[259]). Some institutions also use prizes and awards as a mechanism to incentivise staff to develop pedagogical skills in certain areas of priority. For example, The University of Manchester in **England (United Kingdom)** offers teaching excellence awards in four sub-categories, one of which is excellence in flexible learning and digital delivery (The University of Manchester, 2022^[260]).

Prizes and awards tend to attract staff with expertise in educational research and might therefore be an effective mechanism to incentivise the professional development of teacher educators.

The scientific literature also underlines the importance of strengthening teacher educators' motivation and competencies to engage with and conduct research (Révai and Guerriero, 2017^[47]; OECD, 2019^[18]; Lewis, 2017^[70]). However, integrating educational and disciplinary research into ITE practice is challenging, and requires responses at individual, faculty and organisational level. Teacher educators do not always have the time to engage with or carry out research. Moreover, in academic circles “practice-based research tends to be considered of inferior value, if compared with more traditional types of research, such as theoretical, subject-specific studies” (Lewis, 2017, p. 175^[261]). In addition, while many faculties of education are engaged in educational research, the staff engaged in research and teaching in these institutions are not always the same. Finally, in larger HEIs, there tends to be a risk of institutional fragmentation, with decision-making responsibilities delegated to individual faculties and programme heads (OECD, 2008, pp. 81-2^[262]). In some systems (e.g. **Japan**) ITE is delivered by more professionally oriented HEIs, which do not systematically engage in (educational) research. All of these factors can hinder the integration of research-based and interdisciplinary ways of working into ITE (Roy, 2022, p. 645^[263]).

Integrating competencies for innovation into ITE curricula can be an opportunity to develop interdisciplinary and research-based ways of working. Teacher educators from Tallinn University in **Estonia** noted that, due to the interdisciplinary nature of climate change, the module on “Supporting sustainable thinking” in ITE is being delivered jointly by an ecologist and educational psychologist, as the Department of Education believes that developing teachers' climate change literacy requires a research-based and interdisciplinary approach. The Faculties of Education at the University of British Columbia (UBC) in **Canada**, the University of Helsinki in **Finland**, and the Free University of Brussels in **Belgium (Flemish Community)** also collaborate with faculties across their institutions to deliver multidisciplinary teacher education programmes. For example, the Strategic Plan of UBC's Faculty of Education states the explicit objective of strengthening “inter-institutional partnerships to optimise faculty and student mobility and advancement of research and scholarship” (UBC Faculty of Education, 2019, p. 17^[264]).

National centres of excellence to support peer learning and collaboration among teacher educators and schools

To incentivise and support teacher educators to engage in broad, research-based collaboration and professional learning, including with schools, some jurisdictions have established national support structures for institutions of teacher education. For example, **Norway's** Centre for Professional Learning in Teacher Education (ProTed) is one of eight Centres for Excellence in Higher Education (SFU), established by the Norwegian Agency for Quality Assurance in Education in 2010, to promote quality enhancement in higher education teaching and learning (NOKUT, n.d.^[265]). The Centre supports the quality enhancement of five-year integrated teacher education programmes through five work packages: research-based development of teacher education; systematic work with coherence and progression in studies; systematic work with student active learning; development of partnerships between HEIs and schools; and systematic work to integrate multiple knowledge domains (University of Oslo, n.d.^[266]). A similar initiative is **Finland's** Teacher Education Forum. First established in 2016 and coordinated by the Ministry of Education, the Forum includes representative from HEIs, school education, municipalities, students and other relevant stakeholders. It supports the quality enhancement of teacher education by supporting broad research-based collaboration between teacher educators, researchers and school educators through literature reviews, peer learning and benchmarking. Based on its activities, the Forum has developed national guidelines and priorities for the further development of teacher education in Finland. The challenges for the future of teacher education stated in the guidelines are: “climate change, strengthening inclusion and active citizenship, changes brought about by digitalisation, changing competence needs and the impact of demographic development, regional segregation, migration, and non-discrimination and equality (accessibility)” (Finnish Teacher Education Forum, 2022, p. 6^[267]).

Quality assurance of initial teacher education

Quality assurance is another policy lever used by governments to support the quality enhancement of teacher education. In most systems, the accreditation of ITE programmes follows the same procedures as other higher education programmes. This is the case in **Japan**, the **Netherlands** and **Norway**, for example (OECD, 2019, p. 33^[22]). Some systems have developed specific standards and procedures for ITE. As mentioned earlier in this report, **Ireland** has included specific standards on Global Citizenship Education, Digital Skills, as well as Creativity and Reflective Practice, in its teacher professional standards (Teaching Council Ireland, 2020, p. 14^[233]). In **Australia**, all ITE programmes are subject to initial accreditation (valid for maximum five years) and annual reporting (to support continuous quality improvement) (AITSL, 2019^[268]). In addition to having standards at individual and programme level, “partnerships” are an explicit overarching priority for ITE accreditation:

National accreditation is built around partnerships involving shared responsibilities and obligations among initial teacher education providers, education settings, teachers, employers, and Authorities and a shared commitment to improve initial teacher education and work in partnership to positively affect student learning and graduate outcomes (AITSL, 2019, p. 5^[268]).

While increased focus on digitalisation as part of accreditation processes has received considerable policy attention in recent years (Staring et al., 2022^[237]; OECD, 2023^[250]), more research is needed to examine how ESD can be integrated in the accreditation processes of higher education systems in general, and of teacher education programmes specifically.

Supporting the continuing professional learning of teachers and school leaders

This section discusses two mechanisms through which higher education institutions can support continuing professional learning among teachers and school leaders: 4) the provision of formal and non-formal upskilling and reskilling opportunities, and 5) building school educators' capacity for inquiry, self-evaluation and data analysis.

Mechanism 4: Supporting the upskilling and reskilling of teachers and school leaders

HEIs are the main provider of professional learning for teachers and school leaders across most of OECD and EU jurisdictions, (OECD, 2022^[58]). In professional learning, the research literature makes a distinction between formal, non-formal and informal learning (Werquin, 2010^[269]; Boeskens, Nusche and Yurita, 2020^[226]):

- **Formal learning** involves participation in structured learning with the specific objective of developing competencies. Often, these activities lead to the acquisition of a recognised credential (Boeskens, Nusche and Yurita, 2020, p. 17^[226]);
- **Non-formal learning** is typically “initiated by teachers or groups of teachers [...] intentionally conceived as learning opportunities [...] and] may be externally supported” (Boeskens, Nusche and Yurita, 2020, p. 18^[226]);
- **Informal learning** is characterised by a low degree of formalisation and includes activities such as ad hoc conversations with peers on professional matters, daily interaction with students as part of teaching, learning and assessment activities, or informal mentoring arrangements. While not often visible to school leaders, such learning is “integral to teachers’ professional growth and in some cases, what begins as informal learning evolves into or sparks more formal learning experiences later on” (Boeskens, Nusche and Yurita, 2020, p. 18^[226]).

HEIs can support the formal upskilling and reskilling of teachers and school leaders by developing micro-credentials and targeted degree programmes

Many HEIs offer master’s and postgraduate programmes providing teachers and school leaders with career specialisation opportunities to obtain an extra credential (McGrath, 2023^[272]; Mezza, 2022^[273]). Such programmes often focus on strengthening school educators’ pedagogical skills or disciplinary expertise, including pedagogies related to sustainability and digitalisation. For example, Leiden University of Applied Sciences in the **Netherlands** offers a one-year postgraduate specialisation programme on Digital Literacy and Digital Pedagogy which seeks to develop schoolteachers’ digital competencies as well as how to support the development of learners’ digital competencies (Leiden UAS, 2023^[270]). The University of Gothenburg in **Sweden** offers a two-year master’s programme in ESD. One of the learner groups targeted by the programme are teachers or educators “looking for ideas and strategies to better integrate education for sustainable development in [their] classrooms or in community settings” (University of Gothenburg, 2023^[271]). Comparable international data on the number of master’s and postgraduate specialisation programmes on offer in different OECD and EU jurisdictions that specifically target school educators is not available. There is also no evidence on the uptake and completion rates of such programmes by school leaders and teachers at national level, nor in the areas of ESD and EDD more specifically. However, experts interviewed for this report suggest that full degree programmes might not be the most effective way to support the rapid upskilling and reskilling of school educators needed to accelerate the development and adoption of pedagogies for the digital and green transitions. For many teachers and school leaders, it is challenging to complete a full degree programme on top of their work duties, even if offered in more flexible formats such as online or blended learning. In many education systems, engaging in additional study also does not lead to career advancement, which further disincentivises participation.

To provide school educators with more flexible and targeted opportunities for professional learning, higher education stakeholders noted that micro-credentials can play an important role in supporting the upskilling and reskilling of teachers and school leaders for the digital and green transitions. This is confirmed in the EU’s Council Recommendation on “A European approach to micro-credentials for lifelong learning and employability”, which notes that micro-credentials can “play an active role in delivering on EU policy initiatives to advance the digital and green transitions” (Council of the EU, 2022, p. 4_[272]). While there is no comprehensive data on the total number of micro-credentials on offer across OECD and EU jurisdictions (OECD, 2023, p. 2_[183]), many micro-credentials specifically seek to support the upskilling and reskilling of school educators. A search conducted on 9 June 2023 shows that Coursera offers 923 teaching courses, specialisations and professional certificates specifically aimed at enhancing teachers’ professional learning and development (Coursera, 2023_[273]). The same search for teaching certificates and professional certificates in education on the edX platform shows 130 results (edX, 2023_[274]). Some micro-credentials also specifically seek to develop teachers’ expertise on ESD or EDD. For example, University College Cork in **Ireland** has a dedicated Centre for Continuing Professional Development (CPD) which offers a 10-ECTS credit CPD Certificate in Digital Education (UCC, 2023_[275]) and a 5-ECTS credit CPD Certificate on Global Sustainable Development (UCC, 2023_[276]).

Micro-credentials can play an important role in supporting the upskilling and reskilling of teachers for the digital and green transitions [...] they can [also] be an effective tool to tackle labour shortages.

Evidence also shows that if micro-credentials are developed in close collaboration with employers, they can be an effective tool to tackle labour shortages (OECD, 2023, p. 13_[183]). In recent years, some OECD jurisdictions have therefore started to use micro-credentials as a tool to develop fast-track or alternative pathways into the teaching profession to tackle teacher shortages and support upskilling and reskilling in the profession more generally (OECD, 2020, p. 34_[62]; McGrath, 2023, p. 9_[272]). In **Australia**, for example, one of eight government-funded micro-credentials targeting teachers is a postgraduate certificate on “Mathematics for Out-of-Field Teachers”, with the specific objective of developing alternative pathways into the teaching profession to help tackle teacher shortages. In total, the Australian government is supporting 18 HEIs to develop 28 micro-credentials to help tackle skills shortages in five areas: IT, engineering, science, health and education. Demand for this offer is high, as in total 90 HEIs applied to be part (Clare, 2023_[278]). In the **United States**, the Kansas Division of Elementary and Secondary Education (DESE) offers several micro-credentials at no cost to Arkansas teachers and school leaders (DESE, 2023_[279]).

HEIs can support non-formal learning among school educators by offering online courses, engaging in collaborative research and managing communities of practice

Technological innovations such as massive open online courses (MOOCs) and open educational resources (OER) hold tremendous potential to promote self-study among school educators and mitigate geographical and other inequalities between different schools and teachers arising from the differences in the quality of initial teacher education, or the absence of high-quality educational resources (Boeskens, Nusche and Yurita, 2020, p. 11_[226]). The University of Adelaide in **Australia**, for example, offers a range of free online digital technology courses for teachers (The University of Adelaide, 2023_[89]). Evidence from **Europe** and the **United States** shows that teachers and school leaders are an important consumer group of MOOCs and OER (Seaton et al., 2014_[280]; Castaño Muñoz, Punie and Inamorato dos Santos, 2016_[281]). In Europe, between 10% and 25% of MOOC learners work in the field of education (Castaño Muñoz, Punie and Inamorato dos Santos, 2016, p. 2_[281]). Supporting HEIs to develop online training content that specifically seek to support CPL among school educators may therefore be an effective strategy for governments to consider.

HEIs can also act as “local knowledge hubs” to facilitate more collaborative professional learning among teachers and school leaders. One way in which HEIs can do this is by engaging teachers in collaborative research projects with academic staff, their students and the wider school community. For example, the CREST programme in the **United Kingdom** is a nationally recognised scheme for student-led project work in science, technology, engineering and mathematics (STEM). It gives young people (aged 5-19 years old) the opportunity to collaborate with their teachers and higher education researchers on the design and implementation of a research project. The scheme seeks to “inspire young people to think and behave like scientists and engineers” and provides teachers and home educators with simple and adaptable activities, aligned to the national curriculum (CREST, n.d.^[282]).

HEIs can also play an important gravitational role in building peer learning communities, particularly by offering access to educational research and communities of practice to support more regular peer learning among school educators. During the first online international knowledge exchange webinar of the EIPC Network (18 April 2023), Lewis Molot (Professor Emeritus at York University in **Canada**) argued that HEIs are ideally positioned to manage communities of practice for schools, because “universities and colleges can offer an umbrella under which different school districts can co-operate, harmonise their activities and seek funding”. An example of this in **Germany** is the University of Potsdam’s Teacher Training and Educational Research Centre, which runs Digital Labs. The Centre brings together researchers and schoolteachers working in the State of Brandenburg to share experiences and experiment with the new digital pedagogies (University of Potsdam, n.d.^[283]). The Trieste Education Cluster in **Italy** is a community of practice including research institutions, schools, companies, associations and civil society that seeks to promote active scientific citizenship (Trieste Education Cluster, n.d.^[284]). Groningen University’s “Network North” in the **Netherlands** has a Pedagogical Expertise Centre (*Expertisecentrum Vakdidactiek Noord*) that facilitates peer-learning groups for twelve different school subjects (Groningen University, n.d.^[285]). During the first international online knowledge exchange webinar of the EIPC network (18 April 2023), Saskia Heunks – Programme Leader of the Trion HE-school partnership (Trion, n.d.^[286]) – argued that keeping the size of communities of practice of a manageable size is important to ensure regular and in-depth conversations among stakeholders involved in the community.

Evaluating the impact of professional learning on teachers’ professional practice and student learning is challenging

Measuring the effects of participation in a professional learning activity on teaching practice and student learning is difficult because it requires singling out and linking: a) the participation in a specific upskilling activity (potentially in addition to many other and hard-to-capture informal learning which takes place as part of teachers’ daily professional activities); b) what teachers learn from the activity; c) the changes it has made to their teaching practice; and d) how those teaching practices have impacted student learning (OECD, 2021^[60]). Research suggests that professional learning that benefits student learning generally displays one or more of the following characteristics: it is content-focused; it incorporates active learning utilising adult learning theory; it supports collaboration in job-embedded contexts; it uses models and modelling of effective practice; it provides coaching and expert support; it offers opportunities for feedback and reflection; and it is of sustained duration (Darling-Hammond, Hylar and Gardner, 2017^[287]).

Building on this, the OECD’s teacher professional learning (TPL) study has identified three principles of effectively evaluating professional learning (OECD, 2021, p. 20^[60]): a) professional learning is externally facilitated and helps teachers identify specific goals on how their professional practice will improve their students’ learning experiences; b) the external facilitators, coaches or mentors used are equipped with the skills to undertake evaluations of the professional learning they are facilitating; and c) the professional learning includes a specific focus on incentivising and supporting teachers to undertake regular and critical self-evaluation of their professional learning, and how this relates to the wider goals of their school and school system.

To advance professional learning practice in schools, Boeskens, Nusche and Yurita (2020, p. 15^[226]) identify five key characteristics of successful professional learning:

- **Active role** for teachers (individually or collective) as “reflective professionals”. As discussed earlier in this report (mechanism 1), this is important to develop teachers’ research competencies;
- **Context-based**, recognising the need for schools and teachers to be responsive to the needs of their students and local communities;
- **Evaluative**, with teachers and schools systematically examining the effectiveness of their professional practice. As will be discussed in the next section (mechanism 5), this is important to develop educators’ capacity for self-evaluation and data analysis;
- **Long-term**, meaning that it goes beyond “one-off” course attended and is integrated into regular school life and includes systematically planned opportunities for professional growth; and
- **Leads to change** in teachers’ knowledge base and professional practice. However, as stated above, measuring the change associated with a professional learning activity is challenging.

Incentives are needed to engage school educators in professional learning

There is common agreement among policymakers, practitioners and researchers that incentivising school educators to participate in CPL is important to ensure their disciplinary knowledge and pedagogical practices remain up to date, as this will have a positive impact on student outcomes (OECD, 2021, p. 5^[60]). Some systems have therefore introduced changes to the career structures for school educators to incentivise them to upskill and engage in research. For example, in **Hungary**, a career-promotion scheme introduced in 2013 gives teachers the opportunity to be obtain “researcher-teacher” and “master teacher” status. The aim of the scheme is to enhance teachers’ pedagogical practice by incentivising them to undertake research in the field of education and/or the subject(s) they teach and to contribute to innovation in their own school. For researcher teachers, there is an additional expectation to disseminate the findings of their work more widely to both academic and non-academic circles (OECD, 2022, pp. 91-2^[17]). In **Estonia**, a four-stage career structure for teachers was introduced in 2013. For each career stage, the Estonian Qualifications Authority has developed professional standards, and twice per year teachers can apply for a new certification with the Estonian Teachers’ Association (OECD, 2021, p. 53^[136]).

Teacher educators and higher education experts interviewed for this report also highlighted the importance of providing teachers with transparent and easy-to-access information on available upskilling and reskilling opportunities, for example through online platforms. A promising initiative in this context is **Finland’s** Climate University, established in 2018 by the Ministry of Education and Culture and the Finnish Innovation Fund Sitra. The Climate University is an online platform, which brings together courses on climate change from 27 HEIs. Societal collaboration, including with lower levels of education (i.e. schools), is an explicit priority of the network to support upskilling and reskilling for the green transition (Climate University, 2023^[288]). **Slovenia** also has a national platform with OER for teachers and is planning an ambitious upskilling strategy for teachers’ digital competencies (Knowledge4All Foundation, n.d.^[289]). Several non-traditional providers are also offering teachers easy access to micro-credentials. For example, STEM Minds in **Canada** is offers micro-credentials on a variety of STEM topics (STEM Minds, n.d.^[290]).

For many teachers, conflicts with their work schedule are a barrier that prevents them from engaging in CPL (OECD, 2022^[58]). Some education systems respond to this and offer educators time and financial support to engage in CPL. Professional learning days exist in **Australia (Victoria)**, **Canada** and **New Zealand** (OECD, 2021^[60]). In the **Netherlands**, the Doctoral Grants for Teachers programme seeks to give teachers research experience to strengthen their pedagogical expertise, and to strengthen the links between HEIs and schools. The initiative was launched in 2010, with close to 600 projects funded so far (Dutch Research Council, n.d.^[291]). The Teacher Refund Scheme in **Ireland** provides funding towards the cost of course participation and examination fees upon successful completion of CPL courses by teachers. The funding is available for recognised courses by the Department of Education. 80% of funding is linked

to specific education policy priorities, including “digital technologies in teaching, learning and assessment” and “education in the area of sustainability” (Irish Department of Education, 2023^[292]).

Mechanism 5: Building capacity for inquiry, self-evaluation and data analysis

It is crucial for school leaders to engage in regular, critical, open and collaborative self-evaluation of their own and their teachers’ professional practice, and the wider school climate, to understand how these impact student learning. This will not only help to identify gaps in teachers’ professional practice, but also reveal effective teaching and (formative) assessment practices that might be worth scaling or disseminating at school, school-district or system level. “Most innovations do not start out as billion-dollar ideas. Rather the contrary, often small, seemingly unattractive ideas turn into impactful innovations” (Organizing4Innovation, n.d.^[293]). The OECD has found important links between student well-being and PISA performance in reading, mathematics and science on the one hand and teachers’ enthusiasm, teaching, assessment and student support practices on the other. For example, a supportive and inclusive school climate is particularly important for student learning. PISA finds that students who are more likely to be bullies or bullied obtain lower scores in reading, mathematics and science (OECD, 2019^[22]).

While some form of school self-evaluation has become common in most school quality assurance systems, there are differences in terms of the amount of external support and guidance which schools in different jurisdictions receive to conduct self-evaluation (OECD, 2013^[294]; Maxwell and Staring, 2018^[101]). Finding a balance between school self-evaluation and independent external evaluation is also a challenge for many education systems. Many schools face challenges in developing their capacity to become “Schools as Learning Organisations”, for which Kools (2017, p. 10^[295]) has identified seven key components:

- *Developing and sharing a vision centred on the learning of all students;*
- *Creating and supporting continuous learning opportunities for all staff;*
- *Promoting team learning and collaboration among all staff;*
- *Establishing a culture of inquiry, innovation and exploration;*
- *Embedding systems for collecting and exchanging knowledge and learning;*
- *Learning with and from the external environment and larger learning system; and*
- *Modelling and growing learning leadership.*

Higher education institutions can support self-evaluation and data analysis in schools

Several tools exist that can help schools self-evaluate their capacity for digital and sustainability education (mechanism 1 in this report provides an overview and discussion of some of these frameworks). However, many schools need additional support to conduct effective self-evaluation and use assessment data for school improvement (Maxwell and Staring, 2018^[101]; Rääk, Eisenschmidt and Tammets, 2021^[296]). The widespread use of digital technology in classrooms has made this a more complex task. The rich data that can be generated from learning management systems (LMS) and virtual learning environments (VLE) has multiplied the possibilities for data mining (i.e. the application of data analytics to answer education research questions) and learning analytics (i.e. the use of data analytics to understand and improve teaching and learning) to inform teaching and learning processes (Romero and Ventura, 2013^[297]). There is also an emergence of educational research and student learning outcomes data at international (e.g. PISA, PIRLS and TIMSS) and national levels (e.g. in systems that organise central examinations).

School leaders and teachers also have access to a wide range of more qualitative data, such as feedback from teachers, students, parents, and civil society on the quality of the teaching and learning offered by their institution. Such feedback is often received on an almost daily and highly informal basis. Capturing,

managing, analysing and – most importantly – effectively responding to a proliferation and granularity of data that can inform school improvement and the development of professional learning for teachers requires considerable capacity in schools.

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Some HEIs provide hands-on support to school leaders with self-evaluation and data analysis. By doing so, they can help schools develop a repository of “next practice ideas”, or how current practices could work differently, more efficiently, more powerfully, taking into account failures and thinking about future contexts and scenarios (McGrath, 2023^[272]). For example, Tallinn University’s Future School programme supports schools in **Estonia** to collect and analyse data on students’ learning processes and outcomes. Based on this information, the HEI supports school teams, including teachers and school leaders, to plan, pilot and roll out pedagogical support systems across the school. Between 2017 and 2022, the university supported between 4 and 6 schools each year (Tallinn University, n.d.^[298]). In **Poland**, the University of Warsaw has collaborated with the City Council of Ostrołęka between 2019 and 2023 to develop a series of diagnostic reports for all schools in the region. Based on these reports, cross-cutting issues were identified and discussed with the schools and local authorities to jointly develop school improvement plans. Academics involved in the project offered assistance in implementing those plans and helped to monitor progress (Ostrołęka, 2023^[308]). In this context, the OECD has developed a PISA-Based Test for Schools (PBTS) to help schools measure student learning outcomes in mathematics, science and reading, as well as their socio-emotional skills and well-being. The results are designed “to provide schools with a diagnostic tool to foster reflection, peer-learning and action” (OECD, n.d.^[299]).

HEIs face several challenges in scaling their support for school evaluation, and in enhancing its impact. A first set of challenges relates to “clash of cultures” and “inner/outsider dynamics”, which can hinder schools and HEIs from engaging in open, critical and collaborative evaluative practice. This is often due to “a perceived lack of trust” between both partners and “competing priorities or mandates” (Walsh and Backe, 2013, p. 603^[15]). For example, higher education researchers may want to focus a school’s evaluation on a research question that is not particularly relevant or important to the school or school district. While such an evaluation may yield valuable insights for the educational sector and science more broadly, it may not respond to the specific needs of the individual school or school districts involved in the evaluation. Likewise, the school or school district may wish to focus on questions that fall outside of the areas of expertise or interest of the involved researcher(s). A second set of challenges relates to funding. Many educational innovations and areas for improvement identified as a result of school (self-)evaluations “die before they are fully implemented” (Walsh and Backe, 2013, p. 604^[15]).

Collaboration between higher education and school education for quality assurance in primary and secondary education

In some OECD and EU jurisdictions, school inspectorates who bear formal responsibility for the evaluation and external quality assurance of schools collaborate closely with higher education experts to conduct external evaluations of schools. Collaboration ranges from more ad hoc projects or initiatives (e.g. advice on the methods employed by quality assurance agencies) to more structural involvement of higher education experts in school inspections. In **England (United Kingdom)**, Ofsted primarily employs its own inspectors to carry out external evaluations of schools. Higher education experts are involved to bring in specific expertise on elements such as curriculum design, specific subject knowledge or special

educational needs (Ofsted, 2023^[300]). In **Estonia**, experts from higher education are regularly involved in the external quality assurance of primary and secondary schools on a more regular basis (SICI and Estonian Ministry of Education and Research, 2017^[301]). The **Netherlands** Education Inspectorate (*Inspectie van het Onderwijs*) also collaborates closely with the higher education sector for the evaluation and quality assurance of school education in different ways (see Box 4).

Box 4. Higher education-school collaboration for school inspection in the Netherlands

In the Netherlands, the Education Inspectorate (*Inspectie van het Onderwijs*) has established multiple forms of collaboration with the higher education sector to ensure its evaluation and quality assurance practices for school education align with scientific research on what constitutes good quality education and to innovate approaches to evaluation and quality assurance. Higher education experts contribute to the work of the Inspectorate in the following ways:

- **Advice and review:** Higher education experts provide advice on and review the evaluation methods and reports developed by the Inspectorate.
- **Access to research:** Higher education experts facilitate Inspectorate staff's access to scientific research through conferences, publications and two "scientific chairs" (*leerstoelen*), i.e. two higher education staff members working as "Strategic Inspectors" for the Inspectorate and are given one day per week to conduct targeted research on priority areas for the education sector.
- **Research and evaluation by or in collaboration with researchers:** Higher education experts and Inspectorate staff engage in collaborative research and evaluation of schools. For example, the Inspectorate has recently collaborated with the University of Twente to develop evidence-informed indicators for a monitoring instrument to assess the quality of teaching in primary and secondary education. In June 2023, the Inspectorate published its first set of monitoring reports (Education Inspectorate/University of Twente, 2023^[302]).
- **Practice-based research:** Staff members from the Inspectorate, higher education researchers and practitioners from primary and secondary education collaborate to develop, test and evaluate pedagogical innovations.

In 2018, the Inspectorate also signed a collaboration agreement with the Dutch-Flemish Accreditation Organisation (*Nederlands-Vlaamse Accreditatie-Organisatie – NVAO*), which is responsible for the external evaluation and accreditation of higher education in the Netherlands, and the Higher Education Efficiency Commission (*Commissie Doelmatigheid Hoger Onderwijs – CDHO*), which is responsible for advising the Ministry of Education, Culture and Science on the relevance of proposals for new higher education programmes or programme mergers. The agreement clearly describes the responsibilities of each actor in the education systems, as well as how to collaborate and build on each other's work.

Source: Adapted from Dutch Education Inspectorate (n.d.^[303]), *Het vierjaarlijks onderzoek bestuur en scholen [Four-yearly inspection of leadership and schools]*, <https://www.onderwijsinspectie.nl/onderwerpen/vierjaarlijks-onderzoek/toezicht-op-scholen>; CDHO; NVAO; Dutch Education Inspectorate (2018^[304]), *Samenwerkingsprotocol Inspectie van het Onderwijs, NVAO en CDHO [Collaboration Agreement of the Dutch Inspectorate, NVAO and CDHO]*, <https://www.onderwijsinspectie.nl/onderwijssectoren/hoger-onderwijs/documenten/publicaties/2018/09/24/samenwerkingsprotocol-inspectie-van-het-onderwijs-nva0-en-cdho>.

4. Conclusions and options for further policy and practice development

This section summarises key findings from the report and indicates priorities for further policy and practice development to strengthen higher education's role in supporting teachers and school leaders. The options focus on ways to strengthen teachers and school leaders' disciplinary content knowledge and pedagogical practices, to ensure they are better equipped to help learners develop the broad range of knowledge, skills, attitudes and values needed to shape and absorb innovations for the digital and green transitions.

School educators and leaders need additional support to enhance their capacity to help their students develop competencies for innovation

This report has reviewed available evidence on the readiness of teachers and school leaders to help their students develop competencies for innovation – with a specific focus on research skills and pedagogical skills required to teach digital and climate change literacy. Despite significant investments in teachers' competence development across OECD and EU education systems in recent years, many teachers and school leaders feel insufficiently prepared or supported to equip their students with the competencies most relevant for living and working in greening and digitalising economies.

Challenge 1 – Many teachers feel insufficiently prepared or supported to effectively engage with and use research, or to teach digital and climate change literacy.

While there is no comprehensive and internationally comparable data, evidence suggests that many schoolteachers are insufficiently prepared to effectively engage with and use research, or to teach digital and climate change literacy. A recent OECD survey among representatives from Ministries of Education found that many policymakers believe that teachers are insufficiently prepared and supported to engage with research in the field of education and the discipline(s) they teach (OECD, 2023, p. 66^[64]). One in three teachers in a global UNESCO survey report that they are unfamiliar with suitable pedagogies to support the development of climate change literacy among their learners (UNESCO, 2021, p. 6^[65]). TALIS 2018 shows that, on average across 31 OECD jurisdictions participating in the survey, less than 43% of lower secondary education teachers felt well or very well prepared to use ICT for teaching when they completed their initial teacher education (OECD, 2020, p. 129^[62]). Teachers almost certainly require more explicit training on how to promote digital and climate change literacy in their initial teacher education, as well as opportunities for continuing professional learning and research engagement to update their pedagogical and disciplinary content knowledge as they progress through their careers.

Challenge 2 – School leaders are not always equipped to create 'school climates' conducive to developing competencies for innovation.

School leaders face difficulties in monitoring and responding effectively to their teachers and students' needs for support and professional development. In many cases, they could benefit from additional external advice from higher education experts to build their capacity for 1) critical inquiry, 2) self-evaluation and 3) data analysis, to be able to identify and understand the support and professional learning needs of students and teachers, and develop appropriate responses to foster the development of 'school cultures' conducive to developing competencies for innovation.

Options for strengthening higher education's role in supporting teachers and school leaders to promote competencies for innovation more effectively.

The report identifies five "mechanisms" through which higher education institutions can support teachers and school leaders to adopt pedagogies and practices to promote students' acquisition of competencies for innovation. For each of these, the report examines a selection of inspiring policy and practice examples

from across OECD and EU jurisdictions, including available evidence on the impact of these policies and practices on student learning and teachers' professional practice. For each mechanism, the report has reflected on how public policy can support higher education institutions and schools to engage in more structured and sustained collaboration around initial teacher education and continuing professional learning. Five options for further policy and practice development can be identified.

Option 1 – Develop and include specific requirements on research, digital and green competencies into teacher professional standards, and support their integration in teacher-education curricula.

By integrating a focus on competencies for innovation in their ITE curricula, higher education institutions can help future teachers to develop and adopt the disciplinary content knowledge and pedagogical skills required to help students acquire these competencies. Since in most OECD and EU jurisdictions higher education institutions bear primary responsibility for designing their ITE curricula, many education systems have adopted teacher professional standards to align the content of ITE programmes both within and between different teacher education institutions. However, evidence shows that only in few education systems teacher professional standards include specific requirements related to competencies for innovation – such as research, digital or green competencies. This can lead to large differences between new teachers' readiness to teach competencies for innovation and – as a result – inequities in students' readiness for living and working in digitalising and greening economies. A key priority for policy makers will be to develop – or support the sector-level development of – specific requirements related to education for sustainable development and education for digital competence development, and to support the integration of these competencies into higher education institutions' ITE curricula. Developing professional standards on teachers' research competencies is also key to ensure that school leaders and teachers stay up to date with the latest research and innovations in the discipline(s) they teach.

Option 2 – Support higher education institutions and schools to establish structured partnerships to jointly design, deliver and evaluate initial teacher education programmes that are anchored in pedagogical practice and research.

Higher education institutions can also establish structured partnerships with schools to jointly design, deliver and evaluate the content and delivery models of their ITE programmes with schools, for example through the creation of concurrent teacher education programmes. This can help to ensure that teachers are better prepared for the challenges they will face in the classroom and that ITE programmes respond to the skills needs for teachers identified in schools. Limited resources often create challenges for initiating, scaling and sustaining structured partnerships with schools. In some systems, public authorities offer targeted financial and coordination support to higher education institutions to establish regional networks or partnerships with schools to collaborate around the initial teacher education and continuing professional learning for teachers, and to tackle teacher shortages.

Option 3 – Support the professional development of teacher educators to enhance the quality and relevance of teaching and learning offered in initial teacher education.

To enhance the quality of ITE, an increasing number of higher education institutions are developing faculty or institution-wide teaching and learning standards and incentives for the professional development of their own teaching staff (including teacher educators). However, many teacher educators have limited time or incentives to engage in professional development (which is often not mandatory) or in research. To incentivise and support teacher educators to engage in broad, research-based collaboration and professional development – including with schools – some jurisdictions have established national support structures for teacher education institutions. Other systems have specific evaluation and quality assurance systems in place for initial teacher education.

Option 4 – Mobilise higher education institutions to develop diverse and flexible upskilling and reskilling opportunities on digital and climate change education, and incentivise research engagement among teachers.

Higher education institutions can support teachers and school leaders to update and deepen their pedagogical and disciplinary content knowledge around digital and climate change education by developing master's and postgraduate specialisation programmes, as well as micro-credentials, and incentivising research engagement. Micro-credentials are widely acknowledged as having significant potential to support the rapid and targeted upskilling and reskilling of school educators, as well as help tackle teacher shortages – for example, by developing courses that provide alternative pathways into the teaching profession. In recent years, several OECD and EU jurisdictions have launched national micro-credentials pilots that include a focus on micro-credentials to support upskilling and reskilling in the teaching profession – including on topics such as education for sustainable development or education for digital competence development. Higher education institutions can also support more regular and non-formal learning among school leaders and teachers by developing (online) training courses, managing communities of practice and engaging in collaborative research projects with school educators and students. To incentivise school educators to engage in CPL and research, some education systems have introduced changes to their career structures for school educators, as well as established online platforms providing clear information on available upskilling and reskilling opportunities. While it is challenging to measure the impact of teachers' participation in research or upskilling and reskilling activities, available evidence suggests that CPL is most effective when it is externally facilitated, content-focused, incorporates active learning, has a sustained duration, and promotes regular and critical self-evaluation among participating teachers.

Option 5 – Engage experts from higher education in school self-evaluation and external quality assurance to build the capacity of school leaders and teachers to develop competencies for innovation.

Higher education institutions can support school self-evaluation and data analysis to help school leaders and teachers understand the impact of their pedagogical and professional practices on student learning in general, and how they support the development of competencies for innovation specifically. In addition to identifying and developing strategies to support the CPL of their staff on specific competencies such as digital or climate change education or research skills, externally supported self-evaluation and data analysis can help schools to identify effective teaching or assessment practices that might be worth scaling at institution, school-district or system level. Systemic involvement in or support from higher education experts for school self-evaluation and data analysis, however, is not yet common in many OECD and EU jurisdictions. Higher education facilitated school self-evaluation is also often characterised by challenges such as clash of cultures, a lack of trust or openness and competing priorities between higher education and school-sector partners. In some OECD and EU jurisdictions, public authorities responsible for the external evaluation and quality assurance of schools have established systemic connections with the higher education sector, aligning and co-ordinating the priorities, responsibilities and collaboration methods of higher education and school-sector actors for the evaluation and quality assurance across the education sector.

About this analytical report

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Annexes: Qualitative evidence underpinning the development of the report

Annex 1: Expert interviews

To supplement the desk-based review and analysis of the research literature and inspiring policy/practice examples, the OECD Higher Education Policy Team carried out 45 semi-structured expert interviews between November 2022 and February 2023. These included policymakers, practitioners and researchers coming from 21 OECD and EU jurisdictions: Austria, Belgium (Flemish Community), Canada, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Japan, Latvia, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, United Kingdom and the United States. The interviews were conducted by François Staring and Andrea-Rosalinde Hofer.

The expert interviews have been instrumental for the identification of inspiring policy and practice examples of HE-school collaboration in support of competencies for innovation, and to establish the growing EIPC network.

Annex 2: International online knowledge exchange on how higher education can support teachers and school leaders

Agenda of the international online knowledge exchange

On 11 May 2023, the OECD Higher Education Policy Team organised an international online knowledge exchange (IKE) for the EIPC network on how HEIs, in their role as providers of initial teacher education (ITE) and continuing professional learning (CPL), are adapting to emerging competency requirements for the digital and green transitions, and how public policy can support their efforts. The IKE featured presenters from seven OECD and EU jurisdictions, including presenters from the OECD Centre for Educational Research and Innovation (CERI), and focused on the following three questions:

- 1) What are the **key competencies that teachers and school leaders need** to be able to support their students to develop foundational competencies for innovation?
- 2) How are HEIs embedding these competency requirements in their **initial teacher education and continuing professional learning** offerings for school leaders and teachers?
- 3) What **policy options exist to scale institutional good practice** and support more structured collaboration between schools and higher education to strengthen initial teacher education and continuing professional learning?

Table 3 presents the agenda of the IKE.

Table 3. Agenda international online knowledge exchange on 11 May 2023

14:00 – 14:10	<i>Welcome</i>	<ul style="list-style-type: none"> • Simon Roy, Team Lead, Higher Education Policy, Policy Advice and Implementation Division (PAI), Directorate for Education and Skills (OECD) • Luca Perego, Head of Unit, C1 “Innovation and EIT”, Directorate-General for Education, Youth, Sport and Culture (European Commission)
Session 1 – INITIAL TEACHER EDUCATION: Preparing teachers for the digital and green transitions		
14:10 – 14:15	<i>Introduction</i>	<ul style="list-style-type: none"> • François Staring, Analyst, Higher Education Policy, Policy Advice and Implementation Division (PAI), Directorate for Education and Skills (OECD)

- 14:15 – 14:35 *Impulse presentations*
- Initial teacher education and teachers' competencies – Estonian perspective: **Tiia Õun** and **Grete Arro**, School of Educational Sciences, University of Tallinn (Estonia)
 - Strengthening research competence development in initial teacher education: **Jeroen S. Rozendaal**, Centre for Talent Development, Rotterdam University of Applied Sciences (Netherlands)
 - Education for sustainable development & digital competencies in teacher education in Austria: **Mira Dulle**, Department of Instructional and School Development, University of Klagenfurt (Austria)
 - Developing teacher education through broad research-based collaboration – Finland's Teacher Education Forum: **Marjo Vesalainen**, Ministry of Education and Culture (Finland)

- 14:35 – 15:15 *Moderated panel discussion & questions from the audience*
Moderator: **Nóra Révai**, Analyst, AI and the Future of Skills, Innovation and Measuring Progress Division (IMEP), Directorate for Education and Skills (OECD)

15:15 – 15:30 *Comfort break*

Session 2 – CONTINUING PROFESSIONAL LEARNING: Supporting pedagogical innovation through continuing professional learning for school leaders and teachers

- 15:30 – 15:50 *Impulse presentations*
- "Ambition Loops" – Strengthening innovation and teacher professional identity: **Jason McGrath**, Analyst, Innovation and Measuring Progress Division (IMEP), Directorate for Education and Skills (OECD)
 - In-service training courses on education for sustainable development: **Marco Rieckmann**, Professor of Higher Education Development, University of Vechta (Germany)
 - Training for school leaders to develop innovation culture: **Diana Mesquita**, Faculty of Education and Psychology, Universidade Católica Portuguesa (Portugal)
 - Identifying teachers' professional development needs through evaluation and self-reflection: **Inga Staal Jensen** and **Erik Knain**, Department of Teacher Education and School Research, University of Oslo (Norway)

- 15:50 – 16:30 *Moderated panel discussion & questions from the audience*
Moderator: **Deborah Nusche**, Senior Analyst, Innovation and Measuring Progress Division (IMEP), Directorate for Education and Skills (OECD)

CLOSING & NEXT STEPS

- 16:30 – 16:40 *Reporting on key messages*
- **Andrea-Rosalinde Hofer**, Analyst, Higher Education Policy, Policy Advice and Implementation Division (PAI), Directorate for Education and Skills (OECD)

- 16:40 – 16:50 *Next steps on higher education-school collaboration (EIPC Strand 1): in-depth international knowledge exchange around Peer Learning Anchor (PLA)*
- **François Staring**, Analyst, Higher Education Policy, Policy Advice and Implementation Division (PAI), Directorate for Education and Skills (OECD)

- 16:50 – 16:55 *Commencing work on supporting innovation in higher education programmes (EIPC Strand 2)*
- **Gillian Golden**, Analyst, Higher Education Policy, Policy Advice and Implementation Division (PAI), Directorate for Education and Skills (OECD)

- 16:55 – 17:00 *Closing remarks*
- **Loredana Lombardi**, Policy Officer, Unit C1 "Innovation and EIT", Directorate-General for Education, Youth, Sport and Culture (European Commission)

Key messages emerging from the international online knowledge exchange

The sections below present the key messages emerging from the presentations and discussions with members of the EIPC network during the IKE on 11 May 2023. The inputs provided by the EIPC network have provided the basis for the analysis and conclusions presented in this analytical report.

1) What are key competency requirements for school leaders and teachers?

Participants in the IKE first discussed which competencies higher education providers should focus on more strongly in their ITE and CPL offerings to ensure that teaching professionals are equipped with the knowledge, skills and attitudes to ensure their students develop competencies for innovation. Table 4 Table 4. Key messages from EIPC network on key competencies for teacher and school leader

provides an overview of key competencies emerging from the presentations and discussions.

Table 4. Key messages from EIPC network on key competencies for teacher and school leader

Competencies	Key messages
1. Research competencies	Research competencies emerged as perhaps one of the most important areas to be strengthened in ITE and CPD. Jeroen S. Rozendaal (Rotterdam University of Applied Sciences) defined research competence as “inquiry-as-stance”: the ability to “know how to act in a diversity of complex professional situations”. This includes being able to determine when to update one’s disciplinary and pedagogical competencies; being able to identify, understand and analyse scientific research in a systematic manner to update gaps in knowledge and skills; and applying the findings from research in one’s own pedagogical practice and that of peers, to promote a culture of innovation across the school community. Mr Rozendaal argued that teachers should be trained to become “ <i>brewers of their own coffee</i> ” as opposed to being “ <i>pourers of coffee brewed elsewhere</i> ”.
2. Pedagogical competencies	In addition to developing teachers’ capacity to continuously question and update their knowledge and skills, speakers and participants believed that it is important to ensure teachers feel confident and supported to develop their pedagogical competencies and apply research and innovation in practice. Marjo Vesalainen (Ministry of Education, Finland) and Diana Mesquita (Universidade Católica Portuguesa, Portugal) felt that this is a challenge for many teachers, and that they do not always feel sufficiently supported or incentivised by school leadership to engage in pedagogical experimentation or innovation. Pilot initiatives and professional development for school leaders on how to foster an open culture of innovation were highlighted as two key mechanisms through which public policy could help strengthen the development of innovation cultures in schools. Erik Knain (University of Oslo, Norway) shared reflections on the potential of open schooling and community partnerships to support the development of pedagogical innovation by teachers and school leaders.
3. Digital pedagogy	Integrating digital technology in teaching, learning and assessment was highlighted as one way of stimulating pedagogical innovation. Speakers and participants said that, if used effectively, digital technology has the potential to make learning more inclusive, interactive and collaborative, and support learners’ development of basic digital competencies, which are crucial to function in today’s highly interconnected 21 st century. However, teachers and school leaders need more time, resources and support structures to develop these digital competencies as part of ITE and CPD.
4. Climate change literacy	In addition to being proficient at effectively using digital technology for pedagogical purposes and supporting the development of students’ digital competencies, climate change literacy was felt to be another key competence to embed in ITE and CPD. Since climate change literacy requires an in-depth conceptual understanding of a range of phenomena, and their interconnections, speakers and participants called for <i>all</i> teachers (regardless of the discipline(s) they teach) to develop some level of proficiency on how to teach climate change literacy.
5. In-depth disciplinary knowledge	Another precondition for high-quality teaching and learning lies in teachers’ disciplinary subject knowledge, which enables them to explain concepts in different ways, make connections between different topics, and provide concrete examples of their application to students. As highlighted in Jason McGrath’s presentation (OECD Centre for Educational Research and Innovation), giving teachers opportunities to specialise in their discipline throughout their careers can strengthen their sense of professional identity and promote disciplinary specialisation.
6. Collaboration across disciplines	In addition to developing teachers’ disciplinary knowledge, speakers and participants highlighted the importance of strengthening teachers’ understanding of and ability to work across different disciplines (including industry). This was seen as particularly important to support the development of competencies for innovation, and a profound understanding of climate change.

Note: This table was prepared by the OECD Higher Education Policy Team. It summarises key messages from the presentations and discussions during the IKE on 11 May 2023.

2) What are key trends in initial teacher education and continuing professional learning?

Eight invited speakers from seven OECD jurisdictions and the OECD Centre for Educational Research and Innovation (CERI) briefly shared trends in policy and practice in ITE and CPL as a basis for discussion. Key messages emerging from the presentations and discussions are presented in Table 5.

Table 5. Key messages from EIPC network on trends in ITE and CPL policy and practice

Trends in policy and practice	Speaker	Key messages
Developments in initial teacher education		
1. Integration of sustainability competencies	Tiiu Õun and Grete Arro, University of Tallinn (Estonia)	The University of Tallinn's School of Educational Sciences has introduced an optional module on "Sustainable Thinking Competencies" in its initial teacher education curriculum. The module is delivered in an interdisciplinary way (by an ecologist and educational psychologist) and seeks to develop future teachers' deep conceptual understanding of environmental issues, as well as develop their competencies to engage in and apply scientific research in their daily practice.
2. Strengthening research competence development	Jeroen S. Rozendaal, Rotterdam University of Applied Sciences (Netherlands)	In response to limited guidance at the national and international levels, researchers from four Dutch universities of applied sciences have developed a competency framework on "inquiry-assistance" (IAS). The researchers argue that IAS should be adapted to the professional profile of teachers and integrated across <i>all</i> subjects in initial teacher education (rather than developed through a separate project resulting in a final dissertation).
3. Guidance on digital and environmental education	Mira Dulle, University of Klagenfurt (Austria)	Recent reforms in Austria have led to the integration of basic digital education in the curriculum of middle and lower secondary schools (in 2022-23), and in 2024-25 environmental and informatics education will become 2 of 13 overarching curriculum themes. To prepare teachers and school leaders to respond to these curriculum changes, several competency frameworks have been developed to support the implementation of digital and environmental education in pre-service and in-service teacher education, including one on ESD by the University of Klagenfurt.
4. Research-based collaboration on teacher education	Marjo Vesalainen, Ministry of Education and Culture (Finland)	In 2016, the Finnish Ministry of Education and Culture set up the National Teacher Education Forum, to support research, peer learning and benchmarking to enhance the quality of initial and continuing teacher education. In 2022, the Forum published a Teacher Development Programme, which lists priorities to guide and align the work across teacher education institutions in Finland.
Developments in continuing professional learning		
5. Strengthening teacher professional identity through "Ambition Loops"	Jason McGrath, Directorate for Education and Skills (OECD)	Strengthening teachers' professional identity is crucial to incentivise their continuing professional learning. The "Ambition Loops" model, developed by the Centre for Educational Research and Innovation (CERI), offers a tool to help schools develop bold action statements around which to foster interdisciplinary collaboration between teachers and stakeholders both within and outside the school community (including stakeholders from higher education).
6. Development of upskilling and reskilling courses	Marco Rieckmann, University of Vechta (Germany)	Demand for professional development on education for sustainable development (ESD) in Lower Saxony has increased after the adoption of a decree by the Ministry of Education, stating that ESD should be integrated in all public general and vocational schools and independent schools. In response to this, the University of Vechta has expanded its upskilling and reskilling offer on ESD for teachers and school leaders in the region.
7. Training school leaders to foster innovation cultures	Diana Mesquita, Universidade Católica Portuguesa (Portugal)	Portugal's curriculum reform of 2018, which provided greater autonomy to schools to develop "Innovation Plans" for 25% of the curriculum, has highlighted the need to develop teachers and school leaders' curriculum design expertise. Prior to the reform, there were few opportunities or space for schools to introduce innovations in what or how to teach. To tackle this challenge, the Faculty of Education and Psychology at the Universidade Católica Portuguesa runs a number of training courses and peer learning communities on curriculum design and innovation.
8. Evaluation and self-reflection tools to identify professional development needs	Inga Staal Jensen and Erik Knain, University of Oslo (Norway)	Norway's agency for quality assurance in education, NOKUT, has carried out an evaluation of initial teacher education. Among others, the study found a discrepancy between school leaders and teachers' capacity to assess their competency levels and professional development needs. As part of the SEAS project (Science Education for Action and Engagement towards Sustainability), the University of Oslo has developed a self-assessment tool to assist schools in identifying core principles and best practices for creating and sustaining open schooling collaborations and promoting the scientific skills to engage in addressing real-life, complex sustainability challenges.

Note: This table was prepared by the OECD Higher Education Policy Team. It summarises key messages from the presentations and discussions during the IKE on 11 May 2023.

3) What are key considerations for scaling institutional good practice?

Speakers and participants also reflected on key considerations for scaling institutional good practice in ITE and CPL. Key messages emerging from those discussions are presented in Table 6.

Table 6. Key messages from EIPC network on key considerations for policy makers and practitioners

Considerations	Key messages
Key considerations for policymakers	
1. Develop and promote nationally shared professional standards and guidance	Given HEIs' autonomy over the design of initial teacher education programmes, speakers highlighted the importance of public policy supporting the development and promotion of nationally shared professional standards and guidance for ITE and CPD. Such guidance, they argued, should be developed in close collaboration with researchers, teacher educators, school leaders and teachers, as well as students and parents. Guidance should also be sufficiently detailed to provide support on how to develop specific competency areas in need of strengthening in ITE and CPD. This includes research competencies, digital pedagogy, and climate change literacy (see Table 1 above).
2. Provide access and incentivise engagement in research	Providing access to and developing incentives for school staff to engage in educational research was highlighted as another key area of focus for public policy. Presenters and participants shared examples of national support structures (e.g. EducationLab in the Netherlands) promoting access to and the use of educational research in policy and practice.
3. Support capacity building through research, collaboration and peer learning	Structural collaboration between schools and HEIs that goes beyond school placements for teachers' practical training, as well as collaboration between teacher education institutions, was highlighted as crucial to enhance the quality of teacher education. The creation of dedicated national structures (such as ProTed in Norway or the Teacher Education Forum in Finland) were mentioned as effective policy mechanisms to promote research and collaboration on teacher education. Such collaboration can help ensure that pre-service and in-service training responds to the challenges in educational practice, and (vice-versa) that educational research and innovation find their way into the classroom. Pilot projects supported as part of such partnerships can also support pedagogical innovation.
4. Offer time, resources and recognition for professional development	In addition to developing structures for collaboration, peer learning and research on teacher education, speakers and participants stressed that both teachers and teacher educators need to be given the time, resources and recognition to engage in professional development.
5. Quality assurance of initial teacher education	Quality assurance (QA) was highlighted as another key policy instrument to support the quality enhancement of ITE. By including a focus on specific competency areas (e.g. digital pedagogy or climate change literacy) in accreditation and quality assessments of teacher education, QA agencies can play a role in incentivising HEIs to pay greater attention to developing competency areas that are crucial for the development of competencies for innovation.
Key considerations for higher education institutions	
1. Link teacher education to school curriculum and professional practice	To increase the impact of ITE and CPD, speakers and participants highlighted the importance of linking teacher education to the school curriculum and teachers' professional practice. Structural collaboration between HEIs and schools to co-design, implement and review ITE and CPD will help ensure that teacher education responds to teachers and school leaders' professional challenges, as well as the needs of students.
2. Create synergies in teacher education	Given the potential risk of content overload in already overcrowded ITE and CPD curricula, speakers and participants suggested that HEIs should consider finding synergies between different competency areas. For ITE, this means supporting the integration of new competency requirements across subjects (e.g. cross-curricular integration of research competencies discussed in Table 1); for CPD, this means finding synergies between different CPD courses.
3. Support professional development of school leaders	Given the central role of school leaders in curriculum design, student learning and the professional development of teachers, speakers and participants underlined the importance of HEIs developing (and collaborating on) tailored professional development for school leaders. They argued that such a professional development offer should especially focus on equipping school leaders with the competencies needed to foster open, collaborative, interdisciplinary and evidence-based ways of working between schoolteachers and students.
4. Build on teachers' professional capital	In addition to school leaders, teachers themselves play a key role in driving cultures of innovation and collaboration in their school and local communities. Supporting the professional development of teachers as "local change agents" and capitalising on their motivation, disciplinary and pedagogical expertise were mentioned as a crucial focus area for ITE and CPD.
5. Support the professional development of teacher educators	One of the most important preconditions for effective ITE and CPD are the competencies of teacher educators. Supporting and incentivising their professional development and engagement in research to ensure their pedagogical and disciplinary content knowledge remains up to date should be a key priority for HEIs engaged in ITE and/or CPD for school leaders and teachers.

Note: This table was prepared by the OECD Higher Education Policy Team. It summarises key messages from the presentations and discussions during the IKE on 11 May 2023.

Notes

¹ “Deep-tech” innovation can be defined as bringing together insights from the natural sciences and digital technologies to provide new and cross-disciplinary solutions to global challenges. Among the key skills needed are the ability to manage projects with long time horizons and high risk (Broberg, 2023^[6]).

² Higher education’s role in supporting schools with the integration of competencies for innovation into school curricula is discussed in a separate analytical report prepared by the OECD (OECD, 2023^[1]).

³ Belgium (French and Flemish communities), Denmark, Germany, Estonia, France, Latvia, Lithuania, Luxembourg, Hungary, Malta, the Netherlands, Portugal, Sweden, the United Kingdom (England and Scotland), Iceland, Norway and Serbia.

⁴ Belgium (French and Flemish communities), Bulgaria, Denmark, Estonia, Hungary, Sweden, the United Kingdom (England), Liechtenstein and Iceland.

⁵ Australia, Belgium (Flemish Community), Brazil, Czechia, England (United Kingdom), Germany, Greece, Italy, Luxembourg, Netherlands, Slovak Republic, Scotland (United Kingdom)

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