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DIGITAL SKILLS INTEGRATION IN IVET CURRICULA

How governance frameworks shape implementation across eight European countries

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Chapter 1.
Introduction

Digital transformation is reshaping economies, workplaces, and learning environments across Europe but the workforce and wider population do not yet have the digital skills this transformation requires. In 2023, only around **56 % of people aged 16–74 in the European Union had at least basic digital skills**, covering areas such as information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving, while more than **40 % of adults lacked these foundational competences** (Eurostat, 2023). This gap is mirrored in the labour market: **Over 70 % of businesses have said that the lack of staff with adequate digital skills is an obstacle to investment**. At the same time, skills development is lagging behind technological adoption as around four in ten adult workers indicate that they still need to further develop their knowledge and skills related to AI, while between 40 % to 60 % of EU adult workers display low levels of AI literacy (Cedefop. 2025a). More advanced AI-related practices remain confined to a small share of the workforce, with only 1–4 % of EU adult workers engaging in programming activities using AI tools (Pouliakas et al., 2025). Europe also faces a shortage of digital experts who can develop cutting-edge technologies for the benefit of all citizens. Many jobs now require digital competences even outside traditional ICT roles, and employers report difficulties in attracting staff with adequate digital skills, particularly as technologies such as artificial intelligence, cloud services, and advanced software tools become more embedded in production and services (European Commission, 2025b).

Initial vocational education and training (IVET) at ISCED level 3 plays a critical role in equipping learners with the competences needed for increasingly digitalised economies and for lifelong learning. While EU policy frameworks – including the European Skills Agenda and the Digital Education Action Plan – emphasise the importance of digital skills in VET, the real challenge lies in how these priorities are translated into curricula and training provision.

Across European countries, the pace and depth of digital skills integration in IVET curricula vary dramatically, revealing stark differences between sectors, institutional contexts, and governance arrangements (Cedefop, 2021, 2022a, 2023a; Papazoglou, 2025; Pouliakas & Santangelo, 2026). VET curricula are tightly linked to occupational standards, certification requirements, and governance traditions that prioritise stability, which supports labour market recognition but can limit responsiveness to rapid technological change (Cedefop, 2012, 2021, 2025b). ICT- and engineering-related programmes often demonstrate advanced, systematic adoption of digital competences, whereas service-oriented, health, and craft-based pathways frequently lag behind. Persistent obstacles include governance fragmentation, sectoral disparities, uneven infrastructure, and variations in teacher capacity (Cedefop, 2018, 2023a; Psifidou, 2025b; Psifidou & Symeonidis, 2025; Psifidou et al., 2026). These differences underscore that embedding digital skills in IVET is not merely a technical or content challenge, but a structural and institutional one.

This paper contributes to this evidence base by synthesising eight national reports prepared within Cedefop's study Mapping digital skills in initial VET curricula using natural language processing (NLP) techniques commissioned to Athena Research Center (ARC) ([1]). The selected countries – Germany, Estonia, Greece, Spain, France, Croatia, the Netherlands, and Finland – were chosen to reflect the diversity of European IVET systems, encompassing different governance models, traditions of social partner involvement, and approaches to curriculum reform. Rather than evaluating learning outcomes or implementation effects, the paper focuses on written curricula and examines the structural and policy dimensions of digital skill integration, including curriculum governance, updating processes, stakeholder roles, and integration modalities. It forms the qualitative and contextual component of a broader research project that will also produce NLP-based curriculum analysis, a good practices report, and a skills mismatch analytical framework comparing curriculum supply with labour market demand data from Cedefop's Skills-OVATE tool.

By analysing these eight country cases, the paper addresses three interrelated questions:

(a) How do governance arrangements shape the integration of digital skills in IVET curricula?
(b) How do curriculum updating mechanisms affect responsiveness to technological change?
(c) How do different integration modalities influence consistency and equity across sectors and learners?

In doing so, the paper responds directly to Cedefop's call for more systematic comparative evidence on how digital skills policies translate into curriculum frameworks in IVET and will be part of a series of Cedefop publications and new evidence under the project of 'Mapping digital skills in initial VET curricula using natural language processing (NLP) techniques'. The analysis aims to inform EU-level debate and national reform efforts by identifying structural enablers and constraints, highlighting common challenges, and indicating where policy intervention may be most effective in supporting inclusive, future-oriented digital skills provision through IVET.

The structure of the paper is as follows. Chapter 2 presents the policy background, covering the EU policy frameworks and competence standards shaping the integration of digital skills in IVET. Chapter 3 provides an overview of the current context for the integration, governance, and management of digital competences in vocational education and training. Chapter 4 describes the methodology used in collecting and synthesising national information. Chapter 5 presents concise case studies of each of the eight countries, highlighting governance structures, updating mechanisms, and integration models. Chapter 6 develops a comparative analysis, contrasting centralised and decentralised approaches, transversal and sectoral integration models, and rapid versus slow updating cycles. Finally, Chapter 7 discusses the findings considering broader debates on VET governance, labour market responsiveness, and the balance between stability and innovation. It also outlines key policy messages for EU and national policymakers and concludes with reflections on how the NLP-driven analysis conducted within the Cedefop research project will provide more robust evidence on the prominence of digital skills in IVET curricula.

([1]) The project is carried out by Athena Research Center (ARC) within the framework contract FWC 2024-FWC10/CEDEFOP/2024/OP/0009/NLP awarded following Cedefop's call for tender.

Chapter 2.
Policy background

2.1. The EU policy agenda on digital skills in VET

Digital transformation has become one of the defining challenges for European education and training systems. The diffusion of digital technologies across production processes, work organisation, and service delivery has fundamentally altered the skill requirements of the labour market, increasing demand for both foundational digital literacy and advanced, occupation-specific digital competences. Responding to this challenge has become a central priority for EU policy, which over the past decade – and especially since 2020 – has produced an increasingly dense and coherent framework of strategies, declarations, and instruments aimed at accelerating the integration of digital skills across education and training systems, with VET occupying a prominent position in this agenda.

In 2020, a set of mutually reinforcing policy initiatives established the foundations of the EU's digital skills agenda in VET. The European Skills Agenda constitutes the overarching strategic framework within which digital skills policy is situated. It sets out a ten-year vision for skills development in Europe, identifying digital and green transitions as the twin drivers of structural change in the labour market and positioning VET as a central vehicle for equipping workers and learners with the competences these transitions demand (European Commission, 2020). The Skills agenda introduced quantitative targets for digital upskilling across the working-age population, while calling on Member States to invest in the modernisation of VET systems, strengthen the responsiveness of curricula to labour market needs, and deepen partnerships between education providers, employers, and social partners. In doing so, it established a broad mandate for curriculum reform that extends well beyond the ICT sector to encompass digital skills as a transversal requirement across all fields of vocational education and training.

The Digital Education Action Plan (2021–2027) builds on this foundation and provides a more sector-specific and operationally focused complement to the Skills Agenda. It defines a strategic vision for the development of a high-performing, inclusive, and accessible digital education ecosystem across Europe, and identifies the strengthening of digital competences among learners and educators as one of its two core priorities (European Commission, 2021). For VET specifically, the Digital Education Action Plan underlines the need to embed digital skills systematically within curricula rather than treating them as supplementary or optional, to invest in the digital capacity of education institutions, and to ensure that teachers and trainers have the professional development support necessary to deliver digital learning effectively. It also emphasises the importance of data and evidence in monitoring progress, encouraging Member States to develop reliable indicators for tracking digital skills attainment across education and training pathways.

The Osnabrück Declaration, adopted in 2020 by European ministers responsible for VET, social partners, and the European Commission, complements these strategic foundations by translating them into concrete orientations for VET policy. It calls on Member States and VET

stakeholders to make VET more flexible, inclusive, and future-oriented, with digital and green transitions identified as the primary drivers of reform (Osnabruck Declaration, 2020). On digital skills specifically, the Osnabrück Declaration calls for the modernisation of VET curricula to incorporate emerging digital competences, the strengthening of digital pedagogy, the expansion of work-based learning opportunities that expose learners to digital tools and technologies in real workplace settings, and the development of micro-credentials and flexible learning pathways that allow workers to upskill and reskill in response to technological change. The Osnabrück Declaration is particularly significant in the VET context because it was adopted through a multilateral process involving social partners and national authorities, giving it political weight and a degree of shared ownership that underpins national reform efforts.

Additionally, the Council Recommendation on VET for sustainable competitiveness, social fairness and resilience (Council of the European Union, 2020) has reinforced these orientations, explicitly linking the digital transformation of VET to broader goals of economic resilience, social inclusion, and lifelong learning. It calls on Member States to ensure that initial VET qualifications incorporate digital skills in a systematic way, and that updating mechanisms are sufficiently agile to keep pace with technological change. Together, these instruments constitute a coherent and mutually reinforcing EU policy framework that has placed the digital transformation of VET curricula firmly on the national reform agenda across Member States.

More recently, the policy focus has expanded from digital skills integration to the governance of artificial intelligence (AI) in education and training. Europe has already set a clear strategic direction to promote the digital transition and published European guidelines on the use of AI and data in teaching and learning (European Commission, 2026). The EU Artificial Intelligence (EU AI Act) has classified certain AI applications in education and training as high-risk, and it has set requirements related to data privacy, human oversight, transparency and accountability. More recently, the Commission issued guidelines on prohibited artificial intelligence practices (European Commission, 2025b), providing clarification on AI uses that are explicitly banned under the EU Artificial Intelligence Act. These prohibited practices include, among others, the use of AI systems that deploy subliminal techniques beyond a person's consciousness, exploit the vulnerabilities of specific groups (such as persons with disabilities, children or other vulnerable individuals), or are otherwise designed to materially distort human behaviour in a way that causes or is likely to cause harm. Although not education-specific, these prohibitions are directly relevant for VET, particularly when AI tools are used to monitor learners, analyse behaviour, or make automated inferences about performance or employability.

The Herning Declaration, endorsed by European VET ministers in September 2025, represents the most recent step in this policy trajectory. It builds directly on earlier commitments, extending the shared political vision for VET modernisation through 2030 and placing digitalisation, AI, and skills for the twin transitions at the centre of a renewed agenda for quality, relevance, and attractiveness of VET across Europe (Herning Declaration, 2025).

2.2. European competence frameworks as reference points for curriculum design

The translation of EU policy commitments into curriculum content is mediated by two principal competence frameworks that have become the dominant reference points for defining and organising digital skills across European education and training systems: the Digital Competence Framework for Citizens (DigComp) and the European Skills, Competences, Qualifications and Occupations (ESCO) classification.

DigComp, developed by the European Commission's Joint Research Centre and now in its third iteration (DigComp 2.2 and DigComp 3.0), provides a comprehensive and structured framework for conceptualising transversal digital competences (European Commission, 2017a; Vuorikari et al., 2022). It organises digital competences into five areas: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. Each area is further disaggregated into specific competences, described at multiple proficiency levels that allow the framework to be applied across diverse educational contexts and target groups. DigComp has been formally adopted or referenced in national digital skills strategies across virtually all EU Member States and has been increasingly used as a basis for curriculum design, qualification development, and assessment in both general and vocational education. Its strength lies in providing a common vocabulary and a shared conceptual architecture that facilitates cross-country comparison and policy coordination. However, its generic and citizen-oriented nature means that it does not directly address how digital competences manifest in specific occupational contexts, creating a need for complementary frameworks that link digital skills to work processes and job profiles.

ESCO fills part of this gap by providing a multilingual classification of European occupations, skills, and qualifications that maps digital competences onto occupational profiles across sectors and skill levels (European Commission, 2017b). By linking specific digital skills to the requirements of particular occupations and qualifications, ESCO enables a more granular and labour-market-relevant approach to curriculum design than DigComp alone can offer. It provides a reference for identifying which digital competences are essential, optional, or emerging within a given occupational field, supporting both curriculum developers and social partners in articulating skill needs and updating qualification standards. Cedefop has consistently advocated for the use of ESCO as an operational instrument in VET curriculum reform, emphasising its potential to strengthen the alignment between written curricula and actual labour market demands (Cedefop, 2021; European Commission, 2017b). In practice, the relationship between DigComp, ESCO, and national curriculum frameworks is complex and varies considerably across countries. Some systems have formally mapped national qualification standards onto DigComp proficiency levels or incorporated ESCO descriptors into occupational standards, while others reference these frameworks only indirectly or aspirationally.

2.3. Cedefop's evidence base and the state of digital skills in IVET

Against this policy and framework background, Cedefop builds the evidence base on the state of digital skills integration in IVET across Europe. This body of work provides the empirical and analytical context within which the present study is situated, analysing how digital skills are integrated into IVET curricula at ISCED level 3 to provide evidence on the structural and governance conditions shaping how digital skills are embedded in written curricula ([2]).

Cedefop's research consistently shows that awareness of the need to embed digital skills in IVET is now widespread across European countries, reflecting the impact of EU policy frameworks and national digital strategies (Cedefop, 2021, 2022b, 2022a, 2023a; Papazoglou, 2025; Pouliakas & Santangelo, 2026). At the same time, Cedefop highlights the importance of ensuring that digital transformation in IVET is inclusive and supportive of wellbeing, raising awareness of the risks of digital divides and the potential unequal impact of emerging technologies such as generative AI on learners and teachers, as well as the need to promote digital inclusion and wellbeing (Cedefop, 2026) for both teachers and learners (Psifidou, 2026a; Cedefop, 2026 forthcoming). Most Member States have undertaken some form of curriculum reform to incorporate digital competences, whether through the introduction of dedicated ICT subjects, the revision of occupational standards to include digital skill requirements, or the development of transversal competence frameworks aligned with DigComp (Cedefop & ReferNet, 2025). In several countries, significant investments have been made in digital infrastructure, teacher training, and the development of e-learning platforms and virtual learning environments (Psifidou & Symeonidis, 2025).

However, Cedefop's work also reveals that the depth, consistency, and equity of digital skills integration remain highly uneven. A recurring finding is the distinction between formal curriculum provisions – what is written in official curriculum documents (the 'written curriculum' – and actual implementation in classrooms and workplaces (the 'taught curriculum') (Cedefop, 2012, 2015, 2025b). Even where digital skills are explicitly specified in curricula, their effective delivery depends on infrastructure availability, teacher capacity, and institutional resources that vary considerably across countries, regions, providers, and sectors. ICT- and engineering-related programmes typically exhibit more advanced and systematic digital skills integration, while service-oriented, health, or traditional craft sectors often lag behind, reflecting differences in sectoral digitalisation rates, employer engagement, and the availability of relevant teaching materials and equipment (Cedefop, 2018). Evidence from the pilot European Vocational Teacher Survey (EVTS) further reinforces this implementation gap, highlighting that many IVET teachers perceive a need to strengthen their digital competences as technologies such as simulation environments, digital manufacturing tools, and artificial intelligence become more embedded in VET. While a considerable share of teachers already

([2]) According to Cedefop (2010), 'a curriculum is a normative document (or a collection of documents) setting the framework for planning learning experiences. Depending on the country, the type of education and training, and the institution, curricula may define, among other, learning outcomes, objectives, contents, place and duration of learning, teaching and assessment methods to a greater or to a lesser extent.' The written curriculum, thus, refers to the official educational documents that outline the curriculum.

report using AI tools, many feel insufficiently prepared to identify pedagogically relevant applications and to address associated ethical risks, including bias and unintended negative consequences (Psifidou et al., 2026).

Cedefop has also highlighted the challenge of keeping VET curricula responsive to the pace of digital change. Traditional curriculum revision cycles, which in many systems span several years or even decades, are poorly suited to digital domains where tools, platforms, and work processes evolve rapidly (Cedefop, 2023a). Systems that have invested in institutionalised skills anticipation mechanisms – structured labour market analysis, employer surveys, sectoral foresight exercises – are better positioned to identify emerging digital skill needs and translate them into curriculum updates in a timely manner. Where such mechanisms are weak or disconnected from curriculum governance, digital skills integration tends to be reactive and fragmented. More recently, Cedefop's work has begun to address the implications of advanced digital technologies, including artificial intelligence and automation, for VET curricula, highlighting the growing challenge of preparing learners for workplaces in which AI-driven tools are becoming embedded across occupational fields (Cedefop, 2023a).

This evidence base underlines that the integration of digital skills in IVET is not primarily a technical or content challenge but a governance and institutional one. The capacity of national systems to respond depends on how curriculum authority is distributed, how updating processes are organised, and how social partners are engaged. While the implementation of curricula at provider level lies beyond the scope of this study, this paper examines the structural dimensions that influence it across eight European countries. Building on Cedefop's accumulated evidence, the paper provides a comparative account of how different institutional configurations shape the integration of digital skills in initial vocational education and training.

Chapter 3.
Contextual framework

The integration of digital skills into IVET curricula is not a technical exercise but a structurally embedded policy process. In IVET systems, curricula are anchored in occupational standards, qualification frameworks, certification rules, and governance arrangements that prioritise stability, labour market recognition, and comparability. These institutional features distinguish IVET from more flexible educational domains and condition how rapidly and coherently new competences – particularly digital ones – can be embedded in written curricula. As a result, digitalisation in IVET cannot be understood simply as the addition of new content but must be analysed through the interaction between curriculum design, governance structures, updating mechanisms, and implementation capacity.

3.1. The nature of digital competences in vocational contexts

In vocational contexts, digital competences ([3]) comprise a broad and heterogeneous set of skills that resist simple categorisation. At one level, they include transversal digital skills ([4]) relevant across occupations and sectors (information and data literacy, digital communication and collaboration, content creation, safety, and problem-solving) most conceptualised through DigComp. At another level, IVET curricula must address occupation-specific digital skills: the concrete application of digital technologies within particular sectors and professions. These vary substantially across fields of study. Examples include digital diagnostics and automation in manufacturing, computer-aided design and building information modelling in construction, digital platforms and customer management systems in tourism and retail, electronic health records in healthcare, and data-driven logistics and warehouse management systems in transport. Such skills are typically embedded within vocational modules or occupational standards rather than taught as generic ICT subjects.

From a curriculum perspective, this creates a fundamental tension. Transversal digital skills can be standardised across programmes, providing a minimum floor of digital literacy for all learners and supporting employability, adaptability, and social inclusion. Sector-specific skills, by contrast, depend on occupational structures, employer engagement, and sectoral capacity to articulate skill needs; because of this, they ensure occupational relevance and responsiveness to technological change, but lead to inherently uneven digital skill integration, as some sectors digitalise faster and articulate skill needs more clearly than others. Comparative evidence shows that systems relying exclusively on transversal digital skills risk superficial coverage, while systems relying solely on sector-specific embedding tend to

([3]) According to the Cedefop Glossary, a ‘competence’ can be defined as the ‘demonstrated ability to use knowledge, know-how, experience and – job-related, personal, social or methodological – skills, in work or learning situations and in professional and personal development’.

([4]) According to the Cedefop Glossary, a ‘skill’ can be defined as the ‘ability to apply knowledge and use know-how to complete tasks and solve problems’.

produce fragmented and unequal outcomes (Cedefop, 2018, 2021). In practice, IVET systems combine these approaches in different ways, and the balance between them has significant implications for coherence, equity, and labour market relevance. Understanding this balance is therefore essential for interpreting cross-country differences in digital curriculum reform.

The increasing prominence of advanced digital technologies (artificial intelligence, data analytics, and automation) further complicates this picture. These technologies blur the boundary between transversal and sector-specific skills, as they require both generic digital literacy and specialised technical knowledge. Cedefop's recent work on AI and digitalisation in VET highlights that AI-related skills often cut across occupational boundaries, affecting work organisation, decision-making, and ethical considerations as much as technical tasks (Cedefop, 2023a). This reinforces the need for curriculum models that integrate digital skills horizontally across programmes while allowing for vertical differentiation by sector and qualification level.

3.2. Governance and curriculum reforms

The way digital skills are embedded in IVET curricula is fundamentally shaped by the governance arrangements that govern curriculum design and revision. IVET systems differ substantially in how authority over curricula is distributed between ministries, regional authorities, social partners, and education providers. More centralised systems typically rely on national curricula approved through formal legislative or administrative procedures. These arrangements ensure transparency, national coherence, and equal recognition of qualifications – qualities that are particularly important in vocational systems closely linked to regulated professions and labour market entry. However, centralised governance often implies slower change, longer updating cycles, and limited flexibility to respond to rapidly evolving technological requirements. In contrast, partnership-based or decentralised systems assign a stronger role to employers, trade unions, and sectoral bodies in defining occupational standards and revising curricula. These systems tend to be more responsive to labour market signals but may generate greater variation across sectors, regions, or providers.

Cedefop's comparative analyses highlight that these governance models embody structural trade-offs rather than clear-cut advantages or disadvantages (Cedefop, 2020, 2023a). Centralised systems excel in coherence and equity but face risks of obsolescence in fast-changing digital domains. Partnership-based systems excel in responsiveness and relevance but may struggle with consistency and system-wide coverage. Digital skills bring these trade-offs into sharp relief: technological change accelerates skill obsolescence and increases pressure on curriculum systems to adapt more rapidly than traditional revision cycles allow.

Curriculum updating mechanisms are therefore a critical variable in any comparative analysis of digital skill integration. In many IVET systems, curricula are revised on periodic cycles that may span several years or even decades. While such cycles support stability and planning, they are poorly suited to digital domains where tools, platforms, and work processes evolve continuously. Systems with institutionalised skills anticipation and foresight mechanisms – structured labour market analysis, employer surveys, sectoral committees,

foresight exercises – are better positioned to overcome this challenge, as these mechanisms create feedback loops between labour market developments and curriculum design (Cedefop, 2023a). Where foresight is embedded in governance structures and linked to curriculum revision processes, digital skills are more likely to be integrated systematically and in a timely manner. Where it is weak or disconnected, integration tends to be reactive, fragmented, and uneven.

3.3. Implementation capacity and equity

Even where governance arrangements and updating mechanisms are well designed, the effective integration of digital skills depends on implementation capacity at the level of schools, training providers, and individual teachers and trainers. Across European IVET systems, disparities in digital infrastructure remain significant, particularly between urban and rural areas and between large and small training providers. Cedefop has consistently documented that limited access to modern equipment, software, and connectivity constrains the delivery of digital skills, especially in sectors where technologies are costly or rapidly evolving (Cedefop, 2022b). It should be noted, however, that the present study focuses specifically on curricular design and does not extend to measuring curriculum implementation or assessing learning outcomes among students. Implementation capacity is considered here as a contextual factor that shapes the significance of curriculum provisions, rather than as a direct object of analysis.

Teachers and trainers play a decisive role in mediating curricula and shaping learning experiences (Psifidou, 2025a; Psifidou & Papazoglou, 2026). Embedding digital skills requires not only technical knowledge but also pedagogical capacity to integrate digital tools into vocational teaching, assessment, and work-based learning; this includes the ability to design digitally supported learning tasks, to use simulations and virtual environments, and to guide learners in the critical and responsible use of technology. Cedefop's past analyses indicate that insufficient investment in teacher professional development is a recurrent bottleneck across systems, limiting the effectiveness of curriculum reforms and contributing to uneven implementation (Cedefop, 2023a; Psifidou, 2025b; Psifidou et al., 2026; Psifidou & Symeonidis, 2025). In company-based training, similar challenges arise for in-company trainers, particularly in small and medium-sized enterprises that may lack the resources to invest in advanced digital equipment and staff development.

Equity considerations cut across all these dimensions. Digital skill integration in IVET has the potential either to mitigate or to reinforce existing inequalities. Where digital skills are embedded systematically and supported by adequate infrastructure and teacher capacity, IVET can equip learners from diverse backgrounds with skills essential for participation in the digital economy. Where integration is uneven, learners in less digitally advanced sectors, regions, or institutions risk graduating with limited preparation, exacerbating labour market inequalities. Disparities often align along sectoral lines – ICT- and engineering-related programmes are generally more digitally advanced than service-oriented or traditional fields – as well as along regional and institutional lines (Cedefop, 2018).

Chapter 4.
Methodology

Against this backdrop, this paper conceptualises digital skill integration in IVET as a multidimensional process shaped by four interacting dimensions. The first concerns the structure of IVET curricula and qualification frameworks: which digital skills are included, whether they apply to all learners or only to specific sectors, and how explicitly they are defined. The second concerns governance arrangements and the distribution of curriculum authority, whether this rests with ministries, social partners, regional bodies, or schools. The third concerns stakeholder roles, including social partners, sectoral bodies, and employer organisations, and the processes and frequency of curriculum updating. The fourth concerns the modalities through which digital skills are embedded, alongside recent policy reforms and digitalisation initiatives. The analysis also attends to key strengths, gaps, and outstanding challenges across systems. Rather than treating digitalisation as a binary outcome, the analysis focuses on how different combinations of these institutional features enable or constrain the systematic embedding of digital skills across the eight national systems examined.

This paper draws on a comparative synthesis of eight national reports developed within Cedefop's project *Mapping digital skills in initial vocational education and training (IVET) curricula using natural language processing (NLP) techniques*. The reports were purpose-built for the project and prepared by national experts with in-depth knowledge of their respective IVET systems in Germany, Estonia, Greece, Spain, France, Croatia, the Netherlands, and Finland. Selected for their expertise in VET governance, curriculum structures, and digital skills policy, the experts were tasked with producing systematic, evidence-based analyses of how digital skills are embedded in IVET at ISCED level 3. To ensure cross-country comparability and analytical consistency, all contributors followed a common methodological framework and reporting template developed by Cedefop, covering key dimensions such as curriculum structures and qualification frameworks; governance arrangements and the distribution of curriculum authority; stakeholder roles, including social partners and employer organisations; processes and frequency of curriculum updating; modes of digital skills integration; recent policy reforms; and identified strengths, gaps, and challenges.

The reports draw on a range of primary and secondary sources, including official curriculum documents, occupational standards, national qualification frameworks, legislation and ministerial decrees, policy strategies, and institutional publications. In several cases, experts also drew on evaluation reports, skills anticipation studies, and sectoral analyses produced by national bodies or research institutes. While the precise mix of sources varies across countries – reflecting differences in documentation practices, public availability, and national reporting traditions – all reports rely on authoritative and verifiable materials wherever possible. Where curriculum documents are framed in technologically neutral terms or embed digital skills implicitly rather than explicitly, experts were asked to exercise informed

interpretative judgement and to document the basis for their assessments, ensuring that analytical decisions remain transparent and traceable.

The countries included in the analysis were selected based on a robust set of criteria (Table 1), designed to capture the diversity of European IVET systems in terms of governance models, curriculum traditions, social partner involvement, and approaches to digitalisation. The sample spans highly centralised, partnership-based, and decentralised systems, as well as countries with strong skills anticipation mechanisms and others characterised by slower, decree-based curriculum reform. This variation provides a robust basis for identifying structural patterns rather than country-specific idiosyncrasies.

Table 1. Criteria for the selection of the eight EU Member States

#	Criterion	Rationale
1	Extent of ISCED level 3 IVET	Ensures countries where upper-secondary VET is a substantive part of the education system
2	Recently updated curricula (within the last seven years)	Guarantees access to current curriculum documents reflecting contemporary digital skills policy
3	Geographical diversity (large vs. smaller Member States)	Avoids bias towards any particular country size or regional cluster within Europe
4	Centralised vs. decentralised curricula governance	Captures the full spectrum of governance models shaping how digital skills are embedded
5	Frequency of curriculum updates (rare vs. continuous)	Reflects variation in system responsiveness to technological and labour market change
6	Diverse sector representation in IVET programmes	Ensures comparability across a range of occupational fields with different digitalisation profiles
7	National vs. regional IVET structures	Accounts for differences in the locus of curriculum authority below the national level
8	Variety of IVET responsible authorities	Reflects differences in the institutional actors – ministries, agencies, social partners – holding curriculum responsibility

Source: Cedefop's Call for tender.

The comparative synthesis presented in this paper follows a structured analytical process. First, each national report was reviewed in full to extract information relevant to the analytical framework. Particular attention was paid to how digital skills are defined and positioned within curricula, where they are located within curricula, and how they are supported by governance and updating mechanisms. Rather than coding individual curriculum texts, the analysis operates at the level of curriculum structures, policy arrangements, and integration models, as documented and interpreted by national experts.

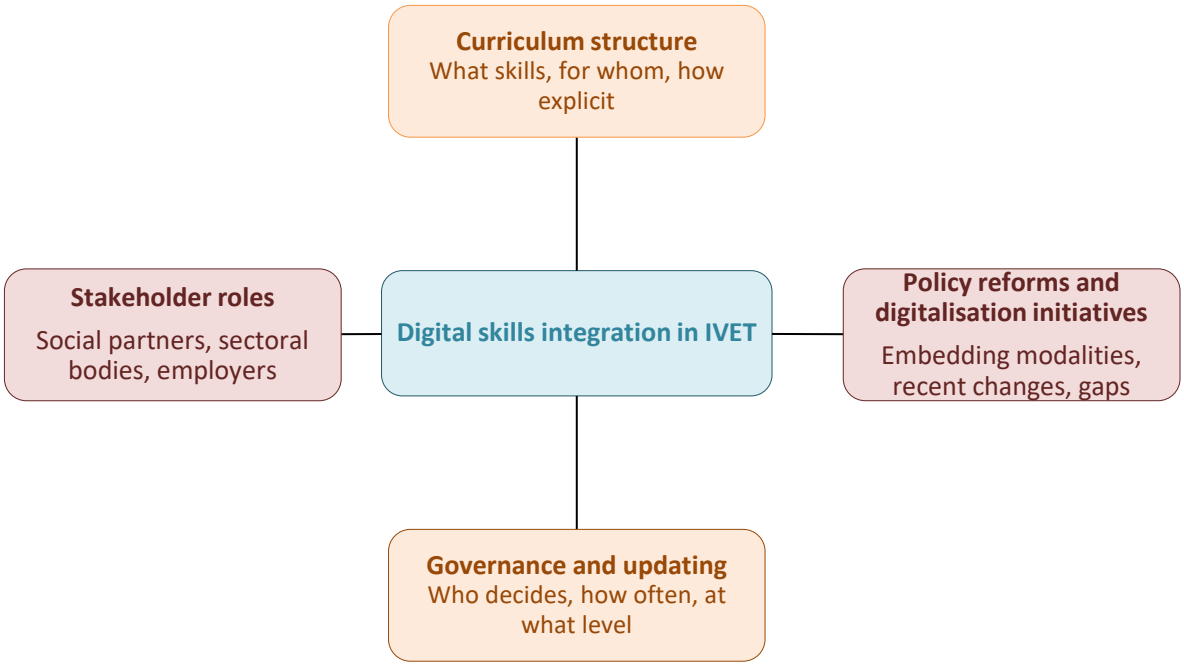
Second, cross-country comparison was conducted by constructing analytical matrices aligned with the core dimensions of the study. These matrices captured differences in governance arrangements (centralised versus partnership-based), curriculum integration modalities (transversal digital skills across all curricula, sector-specific integration, digital skills as elective curriculum elements, or hybrid integration systems), updating mechanisms (continuous, responsive, periodic, or slow), and implementation conditions (teacher capacity, infrastructure, and institutional autonomy). This step enabled systematic comparison across countries and facilitated the identification of recurring patterns and contrasts.

Third, an interpretative synthesis was undertaken to relate observed patterns to broader institutional and policy dynamics. This stage involved moving beyond descriptive comparison to examine how combinations of governance structures, curriculum models, and

implementation conditions shape the integration of digital skills. Throughout this process, the analysis remained anchored in the evidence provided by the national reports and avoided generalisation or extrapolation beyond the scope of the data.

The analytical framework guiding the comparative analysis is presented in Figure 1. It positions digital skill integration in IVET curricula as shaped by four interrelated institutional dimensions: curriculum structure, governance and updating, policy reforms and digitalisation initiatives, and stakeholder roles. These dimensions are treated as mutually conditioning rather than independent, reflecting the systemic nature of curriculum change documented across the eight national cases.

Figure 1. Analytical framework for digital skills integration in IVET curricula



Source: Authors' elaboration.

Although the broader Cedefop project employs NLP techniques to analyse curriculum texts, this paper does not present results derived directly from computational analysis. Instead, it draws on the contextual national reports that provide the institutional, governance, and policy background necessary to interpret automated findings through NLP techniques (to be produced as the next stage of the present research project). The reports supply metadata on curriculum availability, structure, sectoral coverage, and levels of detail, which are essential for understanding both the potential and the limitations of NLP-based curriculum mapping. By focusing on the qualitative and structural dimensions, the paper aims to complement the upcoming computational analysis of the project.

Several methodological limitations should be acknowledged. First, the analysis depends on the availability and accessibility of curriculum documentation, which varies across countries. In some systems, curricula are published in comprehensive, standardised online repositories, while in others documentation is fragmented or less detailed. This affects the level of granularity with which digital skills can be identified and compared. Second, the degree

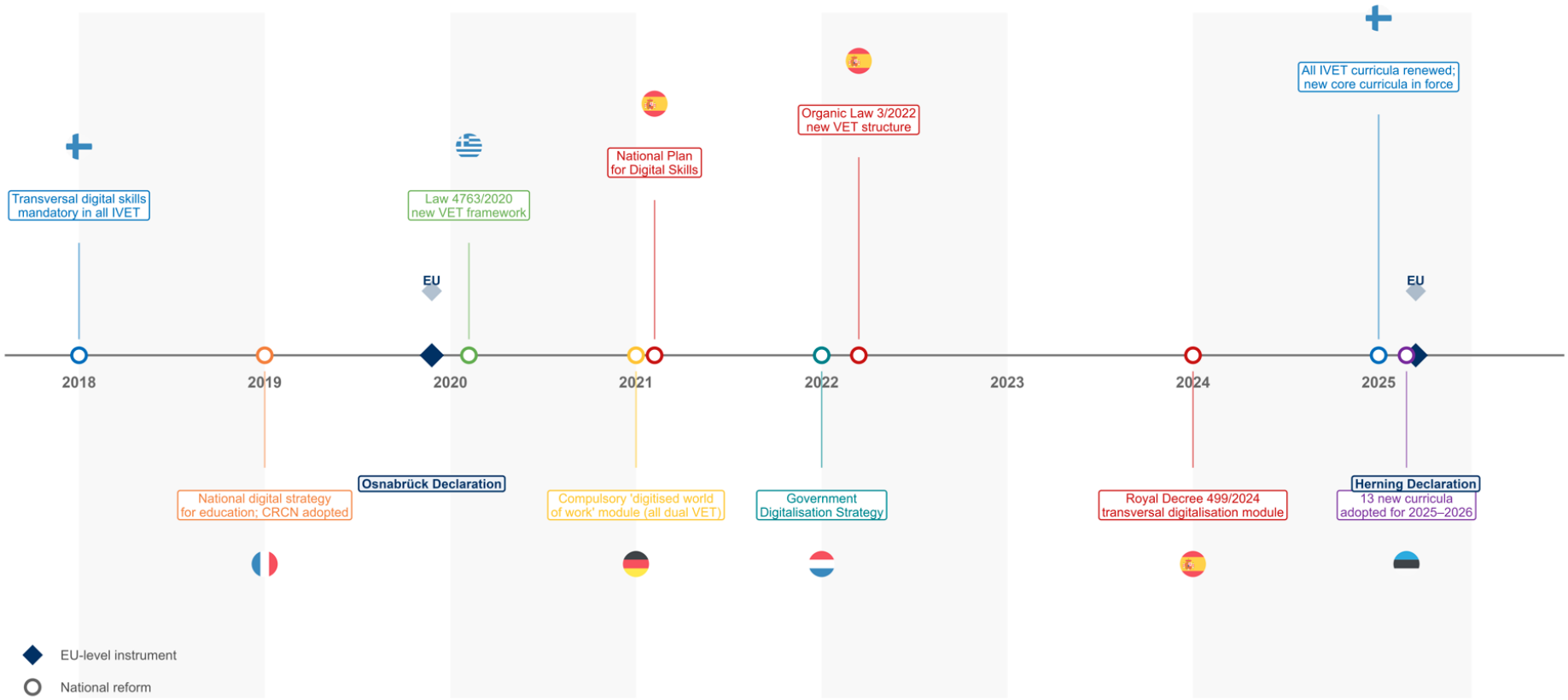
to which digital skills are explicitly specified in curricula varies. In systems that rely on technologically neutral formulations, digital skills may be embedded implicitly, requiring interpretative judgement by experts. While this judgement is informed and systematic, it inevitably introduces a degree of subjectivity. Third, the national reports reflect expert perspectives that may emphasise different aspects of digital skill integration depending on national debates and reform trajectories. To mitigate this, the synthesis focuses on structural features and recurring patterns rather than evaluative claims specific to individual countries. Fourth, the analysis is confined to IVET at ISCED level 3. While higher-level VET and continuing vocational training play an important role in digital skills development, they fall outside the scope of this study. The findings should therefore be interpreted as specific to initial vocational pathways.

Despite these limitations, the methodological approach offers several strengths. The use of harmonised national reports ensures comparability across highly diverse systems while preserving contextual richness. The focus on governance, curriculum structures, and updating mechanisms allows the analysis to address questions that cannot be captured through curriculum text analysis alone. By situating digital skills integration within institutional frameworks, the methodology may support policy-relevant conclusions that go beyond descriptive mapping.

Chapter 5.
Country case studies

Before examining each country in turn, Figure 2 situates the eight national systems within a shared reform chronology. The timeline illustrates that efforts to embed digital skills in IVET curricula have intensified markedly since 2018, with reform activity concentrated in two broad waves. A first wave between 2018 and 2021 saw foundational interventions in several countries: Finland embedded digital skills as a compulsory transversal competence across all qualifications, Germany introduced a universal digitised world of work module across all dual VET programmes, and France adopted the CRCN as a national reference framework for digital competences. A second wave from 2022 onwards has been characterised by a) more comprehensive legislative reforms, most visibly in Spain, where successive royal decrees have restructured the entire VET system and introduced compulsory digitalisation modules, and b) the renewal of EU-level commitments through the Herning Declaration in 2025. Contrary to these trends, Estonia and the Netherlands have pursued incremental reform through continuous updating mechanisms rather than discrete legislative interventions, which means their reform activity is less visible on a timeline but no less substantive in effect. Greece and Croatia show sparser reform activity at the systemic level, reflecting the structural constraints on curriculum updating documented in their respective case studies. This chronological variation provides important context for interpreting the country profiles that follow.

Figure 2. Key national and EU developments in digital skills integration in IVET



Source: Authors' elaboration.

5.1. Germany

Germany's IVET system is internationally renowned for its dual model, which combines company-based training with part-time vocational schooling. This system is underpinned by a complex governance structure that reflects Germany's federal organisation and the strong role of social partners. The federal government, the states (*Länder*), and employers' associations share responsibilities for designing and updating curricula. The principal responsibility for education systems and programmes lies among the Länder, which coordinate with each other through the Standing Conference of Ministers for Education and Cultural Affairs (KMK) ensuring standardisation and coherence. The federal government, on the other hand, is responsible for the company-based part of dual VET programmes, which are structured at the national level. The Federal Ministry of Education and Research (BMBF) enacts training regulations under the Vocational Training Act (*Berufsbildungsgesetz*). The Federal Institute for Vocational Education and Training (BIBB) plays a central role as a competence centre, coordinating the development of training regulations and conducting research. Employer and trade union representatives are directly involved through standing committees, ensuring that occupational standards reflect labour market needs.

At ISCED level 3, IVET -in the strict sense of the word- is split in two different types of programmes: (a) dual VET programmes, offering company-based training and part-time vocational school, and (b) full-time vocational school. These are the only ones giving access to recognised occupational qualifications. According to the 2024 edition of the register of recognised training curricula published by the BIBB, the dual system covers more than 300 recognised occupations, which account for most vocational training places. Each curriculum is shaped by the school curriculum and the relevant training regulation that specifies learning outcomes, duration (typically three to three-and-a-half years), and assessment procedures. The system is deliberately designed to be technologically neutral, defining skills in broad terms to allow adaptation to changing workplace practices.

Digital skills are systematically embedded across all training regulations since 2021, when four compulsory 'standard modules' were introduced: (a) organisation of the training company, labour law, and collective agreements; (b) work safety and health protection; (c) environment and sustainability; and (d) the digitised world of work. The inclusion of the fourth module guarantees that all apprentices acquire transversal digital skills, such as using digital communication tools, managing information securely, and understanding the implications of digitalisation for work organisation. Beyond this baseline, sector-specific digital skills are integrated into relevant occupations. For instance, electrical engineering and metalworking occupations revised in 2018 include training in programming, automation, and digital collaboration tools, while optional modules cover technologies such as 3D printing. In ICT-related occupations, advanced skills in cybersecurity, software development, and cloud computing are embedded.

Germany's skills anticipation efforts are reflected in targeted national initiatives. The VET 4.0 initiative investigated opportunities for adapting existing training occupations to the needs of Industry 4.0, including cloud technology, advanced analytics, machine learning, and

additive manufacturing. In parallel, the InnoVET programme (2020–2024) supported pilot projects to develop innovative practices for digital skills delivery, including training modules on artificial intelligence designed as optional components for potential incorporation into existing curricula. The outcomes of these initiatives may feed into future curriculum development and revision.

Curriculum updating in Germany is continuous but not uniform across occupations. The stability of VET curricula reduces the need for frequent revisions, while industry involvement ensures that new technologies are integrated through workplace training. In technology-intensive fields, such as ICT and engineering, curricula may be revised every four to five years. In other occupations, revisions occur less frequently, sometimes spanning a decade, reflecting the deliberate neutrality of training regulations. The updating process is collaborative: it is always initiated by a joint proposal of the national umbrella organisations of employers and the trade unions, addressed to the federal government. It is then processed by the BIBB with the consultation of other stakeholders. Once a revision is approved, working groups of employers, unions, and experts develop the updated regulation, which is then enacted by the federal government. The Länder subsequently align their school curricula with the revised training regulation. This system ensures both national consistency and strong labour market relevance.

Industry involvement is particularly decisive in Germany. Training is delivered in companies, which design in-company training plans based on national regulations but tailored to their technological context. Chambers of commerce and industry, as well as chambers of skilled crafts, supervise training quality and assessments. BIBB supports the process with practical manuals (*Ausbildung gestalten*), which provide trainers with detailed guidance, including examples of digital tasks and learning assignments. These manuals play a crucial role in translating the broad frameworks of training regulations into concrete implementation.

Although a basic level of digital literacy is guaranteed in all IVET curricula, digital skills at higher levels are predominantly found in IVET curricula in the various sectors of engineering and technology. Challenges regarding the appropriate development of digital skills are reported from the sector of skilled crafts, which involve a great deal of manual labour, and are believed to be incompatible with the use of digital technology. For this reason, companies in this sector, especially smaller ones, are often reluctant to adopt digital tools and to invest in the development of digital skills. Moreover, regional disparities persist, with urban centres offering more opportunities for digital learning than rural areas.

Overall, Germany demonstrates how a tripartite governance model and strong social partner involvement can drive systematic integration of digital skills into IVET. The combination of the compulsory digitisation module and sector-specific revisions creates a robust framework, while workplace training ensures practical relevance. However, the neutrality of training regulations may slow the integration of emerging technologies. Company-level implementation under this system introduces variation, highlighting the ongoing need for regular updates, targeted teacher training, and support measures for smaller enterprises. Germany thus represents a model of structured but flexible integration, where digital skills are embedded as part of a broader strategy to sustain the dual system’s responsiveness to technological and economic change.

5.2. Estonia

The Estonian IVET system is structured around a competence-based model that is closely aligned with the national qualifications framework (EstQF) and supported by systematic skills foresight. Governance is shared between the Ministry of Education and Research, which sets the overall policy direction and prepares the national curriculum, and education providers, which enjoy a degree of autonomy in implementing and approving curricula at school level. A defining feature of the Estonian system is that the school curricula need to conform to both the occupational standards, and the national curricula. Occupational standards, developed by working groups with strong involvement from social partners, determine the expected learning outcomes and competences for each qualification, thereby ensuring a close link between education and labour market requirements.

At ISCED level 3, IVET is offered mainly through vocational schools, governed by the state, local governments, or private providers, which combine school-based learning with workplace training at different rates. National curricula are based on the so-called curriculum groups. Programmes vary in duration and structure but are consistently organised around occupational standards. The outcome-based and modular structure of Estonia's curricula creates a high degree of standardisation in terms of expected learning outcomes, while also allowing providers flexibility in teaching methods and the organisation of school- and work-based learning. The governance model is thus one of guided autonomy: national standards provide a uniform framework, but implementation is adapted by institutions to their contexts.

Digital skills in Estonia are specifically mentioned in the Standard of Vocational Education and primarily embedded in IVET through occupational standards and national strategies. They are separated into three categories: a) generic work life skills, including basic digital literacy skills seen as transversal and integrated across all qualifications; b) field-/occupation-specific skills, including digital skills adapted and relevant to concrete skills of professional activity; and c) skills specific to the ICT sector, including skills in programming, networking, and cybersecurity. In service sectors, digital marketing, e-commerce, and customer management tools feature increasingly in curricula. The extent of integration varies, but the national approach ensures that all learners are expected to acquire at least a minimum level of digital skills.

A critical element of Estonia's approach is the Estonian labour market monitoring and future skills forecasting system (*Oskuste arendamise koordinatsioonisüsteem - OSKA*). OSKA conducts systematic sectoral analyses of labour market developments, identifying emerging competences and future skill needs. These studies directly inform the updating of occupational standards, which in turn drive curriculum revisions. This creates a feedback loop between foresight, standards, and curricula, ensuring that digital skills are continuously monitored and integrated where relevant. For example, OSKA analyses have highlighted the growing importance of data analytics, automation, and green-digital skills, leading to updates in several vocational standards. The OSKA system informed policies adopted between 2014 and 2020, promoting digitalisation and focusing on incorporating digital culture in all curricula and across all education levels.

Curriculum updating in Estonia typically follows a five-year cycle for occupational standards, but revisions can occur earlier if prompted by technological or labour market

change. VET curricula are prepared by schools and then submitted to the Vocational Education Curricula Commission of the Ministry of Education and Research. At the school level, the process is led by the School Council and involves stakeholders, such as employers, trade unions, and education experts. Once approved, and if they are compliant with the national curricula, new curricula are registered in the Estonian Education Information System (*Eesti Hariduse Infosüsteem - EHIS*), ensuring national consistency while allowing local adaptation. This system creates a balance between stability and responsiveness, though the speed of updates can still lag behind the fastest-moving technological fields. The national secondary VET curriculum is currently being updated, with changes in modules and the adoption of 13 new curricula for 2025-2026.

Industry involvement in shaping digital skills is strong. Industry stakeholders participate directly in the development of occupational standards and in the organisation of workplace training, and they participate in school-level Advisory Bodies. This ensures that curricula reflect current workplace practices and that learners are exposed to digital tools in authentic settings. For example, in ICT programmes, collaboration with companies has supported the integration of coding, cybersecurity, and cloud technologies, while in logistics, digital supply chain management tools have been introduced through industry input.

Despite these strengths, the Estonian report highlights some disparities. Digital infrastructure and teacher competences vary between institutions, with rural schools sometimes facing resource constraints. The biggest regional disparities, however, concern internship opportunities, which are mostly concentrated in urban centres, and especially Tallinn. While national strategies emphasise digital pedagogy, teacher training and continuing professional development remain uneven, limiting the effective delivery of advanced digital skills in some contexts. Nevertheless, it is important to note that, for the period 2023-2029, EU structural funds have been allocated to new learning materials to support the implementation of the updated curricula, as well as to the development of methodological guidelines for teachers and teacher training. The Education and Youth Board (Harno) also offers teachers' guidance services and methodological guides to VET educators. Lastly, despite the transversal integration of digital skills in general curricula, sectoral differences persist: ICT, logistics, and creative industries tend to be more advanced in integrating digital skills, while hospitality, agriculture, and personal services lag behind. Addressing these disparities remains an ongoing challenge.

Overall, Estonia represents a case where strong dual-structure (national and school-level) governance, systematic foresight, and stakeholder involvement provide a solid framework for embedding digital skills in IVET. The integration is structured and forward-looking, driven by occupational standards that are regularly revised in light of OSKA analyses. However, challenges related to infrastructure, teacher preparation, and meeting different skills needs across sectors highlight the necessity to complement policy frameworks and curriculum structures with targeted support measures. Estonia thus demonstrates how a small, digitally advanced country can leverage foresight and competence-based curricula to promote digital skills, while also highlighting the ongoing need to strengthen implementation capacities to ensure these policies are fully realised.

5.3. Greece

The Greek IVET system is highly centralised, with the Ministry of Education, Religious Affairs and Sports (YPAITHA) exerting primary authority over curricula. It defines national policy, approves curricula, and oversees the operation of vocational schools, while the Ministry of Labour and Social Affairs plays a complementary role in apprenticeship programmes delivered by the Public Employment Service (DYPA). Key supporting bodies include the Institute of Educational Policy (IEP), which designs and reviews curricula, and the National Organisation for the Certification of Qualifications and Vocational Guidance (EOPPEP), which ensures alignment with the National Qualifications Framework and occupational standards, and supervises certification. This centralised governance ensures uniform standards across the country, providing system-wide consistency while also highlighting the necessity to strengthen institutional flexibility and autonomy, and enhance responsiveness to evolving labour market needs.

At ISCED level 3, Greece offers multiple IVET pathways. The most common are Vocational Upper Secondary Schools (EPAL), which combine general education with sector-specific training over three years. Experimental EPALs (PEPAL) pilot innovative curricula and teaching methods, often with closer links to industry and higher education, and benefit from more institutional autonomy. Apprenticeship Schools (EPAS) under DYPA follow a dual system that integrates paid work placements with classroom instruction, while Experimental EPAS (PEPAS) focus on tourism and hospitality. Vocational Training Schools (ESK) offer two-year programmes for lower-secondary graduates, oriented towards traditional trades and crafts. While the diversity of pathways provides multiple entry points, curricula across all institutions are centrally defined, with limited scope for schools to adapt content to local needs.

Digital skills are included across programmes but vary in depth and coherence. Basic digital literacy is integrated into general education subjects, ensuring that all students acquire fundamental skills. More advanced skills appear in ICT-related sectors and in experimental schools. However, digital skills embedded in the curricula are often outdated or lack coherence outside the ICT domain. PEPAL and PEPAS institutions embed transversal digital skills, such as online collaboration, digital safety, and the use of modern platforms, alongside sector-specific applications like digital hospitality management. By contrast, mainstream EPALs and EPAS schools face challenges in rapidly integrating newer digital tools, an area targeted by recent reform and funding programmes. ESK programmes often remain focused on traditional trades with limited digital integration.

National strategies have placed increasing emphasis on digitalisation. The Digital Transformation Bible 2020–2025 (*Βίβλος Ψηφιακού Μετασχηματισμού 2020–2025*) promotes digital literacy across education, while the National Recovery and Resilience Plan (Greece 2.0) provides funding for pilot initiatives and infrastructure. Law 4763/2020 established a new framework for VET and lifelong learning, aiming to strengthen links with the labour market, and promote green and digital transitions. Advisory bodies such as the Central VET Council (KSEEK) and regional Councils for Linking VET with Employment (SSPAE) provide mechanisms for social partner involvement, although their role is consultative rather than binding. In practice, employer input has more influence in experimental institutions than in mainstream schools.

Curriculum updating in Greece follows a periodic pattern, with revisions typically every five to seven years, though external reforms or EU-funded projects can trigger earlier changes. The process is centrally coordinated by the IEP and EOPPEP, with formal consultation involving employers, unions, and teacher representatives. Stakeholder participation occurs mainly through advisory bodies such as the Central VET Council (KSEEK) and regional Councils for Linking VET with Employment (SSPAE). Once approved by the Ministry, new curricula are rolled out nationwide, while older versions remain valid until all enrolled students complete their programmes. This ensures continuity but limits agility in adapting to technological change. Experimental schools often act as testing grounds, piloting digital modules that may later be extended system wide.

Industry involvement in digital skills development is growing but uneven. At the national level, employers contribute to advisory councils and qualification standards. At the local level, partnerships between schools and businesses are strongest in experimental schools, where collaboration leads to curriculum innovations and exposure to modern digital tools. In mainstream institutions, however, engagement is more limited and depends on the initiative of individual schools or regional labour market conditions. Experimental institutions such as PEPAL and PEPAS benefit significantly from in-school partnerships with businesses. However, the extent and effectiveness of industry input vary widely. In technologically advanced regions or sectors, schools are better positioned to align with digital skill requirements.

Digital skill integration across IVET in Greece is uneven, influenced by institutional, geographic, and sectoral factors. On a first level, institutional disparities are predominant; experimental schools like PEPAL and PEPAS demonstrate greater innovation by incorporating transversal digital competences. These schools often benefit from EU funding or industry collaborations. Moreover, digital pedagogy remains immature due to limited infrastructure and insufficient teacher training. For this reason, systemic integration of advanced digital content like coding, cybersecurity, or data analysis is largely dependent on project-based interventions. On a second level, big urban centres benefit from better infrastructure, more experienced staff, and greater access to funding and projects. In contrast, rural and island regions often face equipment shortages, weak connectivity, and limited teacher capacity, creating a digital divide. Lastly, on a third level, ICT, engineering, and logistics-related programmes generally include stronger digital components, while sectors like hospitality, aesthetics, or agriculture may lack up-to-date digital content unless driven by employer demand or external funding.

In summary, Greece illustrates both the potential and the constraints of a centralised system. The existence of multiple IVET pathways provides opportunities to pilot innovative digital content, particularly in PEPAL and PEPAS institutions. Ambitious reforms and targeted pilot initiatives demonstrate commitment to digital integration and are progressively aiming to extend innovation across the system. On the other hand, the centralised governance structure slows down updates and reduces institutional flexibility. The duality between experimental and mainstream schools highlights the need for mechanisms that can diffuse innovations more rapidly across the system. Ongoing investments in teacher training, infrastructure, and employer engagement aim to bridge these gaps and promote more equitable digital skills

development. Greece thus represents a system in transition, where reform momentum is evident and recent initiatives show promising pathways for fully mainstreaming digital skills in IVET.

5.4. Spain

The Spanish IVET system is governed through a complex multi-level arrangement that combines strong national steering with significant responsibilities for the 17 autonomous communities. The Ministry of Education and Vocational Training (MEFP) sets the basic curricular elements and overall policy framework and establishes the learning outcomes, while regional authorities design, implement, and manage education policies, and regulate non-basic elements of IVET curricula. This shared governance ensures both homogeneity across the national system and flexibility to address regional needs.

At ISCED level 3, IVET corresponds to the Intermediate VET programmes (*Grados Medios de Formación Profesional*), which typically last two academic years (2 000 hours) and combine school-based learning with compulsory work-based training modules (*formación en centros de trabajo*). In some cases, programmes are delivered in dual format, extending to three years with a stronger apprenticeship component. These Intermediate VET programmes deliver full VET qualifications (VET diplomas) that have academic and professional validity.

Digital skills in Spanish IVET are embedded in multiple ways. First, the transversal digitalisation module, 'Digitalisation applied to productive sectors', introduced through the 2021 National Plan for Digital Skills, provides a baseline for all learners, focusing on information management, online collaboration, cybersecurity, and digital safety. Second, sectoral curricula integrate digital applications relevant to each professional family. For example, ICT and electronics programmes include advanced training in programming, 5G networks, and the Internet of Things (IoT), while tourism and hospitality programmes increasingly cover digital reservation systems and customer management platforms. Third, Spain has introduced specialisation courses (*cursos de especialización)* for VET graduates, offering advanced training in fields such as hybrid and electric vehicle maintenance, IoT system management, and 5G network implementation. These courses, lasting between 300 and 720 hours, complement initial qualifications and provide a mechanism to rapidly adapt to technological change.

Spain has undertaken major reforms in recent years to strengthen and modernise its VET system. The Organic Law 3/2022 established a new structure of VET pathways, and subsequent decrees, including Royal Decree 499/2024, have embedded transversal modules on digitalisation, sustainability, entrepreneurship, and technical English across all intermediate VET programmes. This reform represents a decisive step towards systemic integration of digital skills, ensuring that every student, regardless of sector, acquires core digital skills. Furthermore, Royal Decree 69/2025 introduced a new VET branch on Artificial Intelligence and Data, signalling a strategic move to align qualifications with emerging technological fields. Spain has also invested heavily in digital infrastructure to support curriculum modernisation. A prominent example is the creation of Applied Technology Classrooms (*Aulas ATECA),* which are innovative spaces within VET centres equipped with technologies such as virtual reality,

3D printing, and artificial intelligence, and aim to simulate real-world work environments and provide students with firsthand experience of advanced digital tools.

Curriculum updating in Spain is structured but also responsive to sectoral developments. National occupational standards, defined in the National Catalogue of Professional Qualifications (*Catálogo Nacional de Cualificaciones Profesionales* - CNCP) and the National Catalogue of Professional Competence Standards (*Catálogo Nacional de Estándares de Competencias Profesionales* - CNECP), form the backbone of curricula. These standards are developed by the National Institute of Qualifications (INCUAL) in collaboration with social partners and are regularly reviewed to reflect labour market needs. Updates are typically initiated when standards are older than five years, though significant technological changes can trigger earlier revisions. Once occupational standards are updated, they are translated into curricula through royal decrees, which are binding across the country but allow regional adaptations. This process ensures alignment with the CNCP and maintains coherence between qualifications and occupational profiles.

Industry involvement in shaping digital skills is embedded in the governance of VET. Employers and unions participate in the tripartite General Council for VET, and sectoral experts contribute to the development of occupational standards and curricula. Regional authorities also engage local businesses in dual VET programmes, ensuring that learners gain workplace experience with up-to-date digital systems. However, the extent and quality of employer engagement vary across regions and sectors, reflecting Spain's decentralised structure.

Despite homogenisation and standardisation efforts for digital skill integration with the Royal Decree 499/2024, the degree of integration of digital skills across different Intermediate VET programmes varies considerably. Thus, technical VET programmes related to ICTs and computer, communications or electricity and electronics frequently integrate advanced digital competences. On the contrary, service-oriented Intermediate VET programmes (e.g. catering and tourism or personal image) devote less attention to digital skills. There is also considerable variability in digital skills integration across different vocational sectors, for instance computer and communications or engineering, as opposed to catering or tourism study programmes. Lastly, regional differences in infrastructure and teacher training present challenges in achieving equitable and consistent implementation.

In sum, Spain represents a system undergoing rapid digital modernisation, with strong national reforms providing systemic guarantees for digital skills, complemented by sector-specific integration and advanced specialisation courses. The introduction of compulsory digitalisation modules across all intermediate programmes ensures a universal baseline of skills, while specialisation courses provide a flexible mechanism to adapt rapidly to technological change. While regional disparities and sectoral imbalances persist, Spain's recent legislative and infrastructural initiatives position it as one of the more ambitious reformers in embedding digitalisation into IVET curricula. The combination of transversal modules, sectoral applications, and forward-looking specialisations offers a comprehensive approach, albeit one that requires sustained investment in teacher training and regional capacity-building to achieve full and equitable implementation.

5.5. France

The French IVET system is characterised by a highly centralised governance model, in which the Ministry of National Education, Youth and Sports exercises near-complete authority over curricula, qualifications, and certification; the French system is, thus, characterised by high standardisation and formalisation levels of teaching and assessment tools. Established in 2014 within the Ministry, the Digital Education Directorate (DNE) is responsible for defining policies related to the development of digital education. Since 2018, social partners have been authorised to participate in decision-making bodies related to vocational certifications, issuing binding opinions. Schools and VET providers retain minimal authority over the content or the structure of the curricula.

At ISCED level 3, IVET is delivered primarily through two main pathways: the Certificate of Professional Aptitude (*Certificat d'Aptitude Professionnelle* - CAP) and the Professional Baccalaureate (*Baccalauréat Professionnel* - Bac Pro). CAP programmes last two years and focus on entry-level qualifications for direct labour market insertion with a strong focus on practical training, while Bac Pro programmes last three years and provide more advanced qualifications that may also allow progression to higher education. Both are structured around nationally defined curricula, which combine general education subjects with vocational modules specific to each occupational field. Lastly the technological Baccalaureate (*Baccalauréat Technologique* - Bac Techno) offers a mix of professional and academic streams, some of which can also allow progression towards higher education. All ISCED level 3 programmes are provided either through schools or Apprenticeship Training Centres (CFA).

Digital skills in France have been progressively integrated into IVET curricula, particularly since the adoption of the 2019 national digital strategy for education. The Digital Competence Reference Framework (*Cadre de Référence des Compétences Numériques* – CRCN), aligned with the European DigComp framework, establishes reference levels for digital skills across five dimensions ([5]). Its implementation has been supported by the PIX platform, which provides digital skills self-assessment and certification for students. These initiatives signal a national commitment to transversal digital skills.

Despite policy efforts to digitalise IVET, the methods for integrating digital skills into curricula remain relatively uneven. In many cases, they are listed as tools for use without detailed descriptions of operational capabilities or how they should be applied in vocational practice. Bac Pro programmes tend to embed digital skills more systematically, both in transversal modules and sector-specific content, while CAP programmes still show weaker integration. Many curricula continue to emphasise traditional practices, and digital skills are often limited to basic literacy without structured inclusion in vocational modules. Ongoing initiatives, such as the Digital Strategy for Education 2023–2027, the Digital Education Agenda 2023–2027, and the Digital Education Territories (*Territoires Numériques Educatifs*), aim to

([5]) Information and data; communication and collaboration; content creation; safety and protection; and digital environment.

support more systematic teacher training and curriculum development. Nonetheless, the divide remains: Bac Pro students are more likely to graduate with robust digital competences, whereas CAP students may have more limited preparation for a digitally evolving labour market.

Curriculum updating in France follows a centralised, decree-based process under the Code of Education *(Code de l'Éducation)*. Revisions are initiated by the Ministry, often in response to labour market changes or broader policy reforms, but the pace of updates is slow which can limit the relevance of CAP curricula in rapidly digitalising sectors. Many CAP curricula have not been revised for over 15 years, while Bac Pro curricula are updated more frequently, reflecting their closer alignment with industry demands and their higher qualification level. Since the 2018 reform, employer organisations and social partners have gained greater influence in curriculum development through vocational certification bodies and tripartite Professional Consultative Commissions (CPC), helping to ensure that curricula reflect labour market needs. Nevertheless, ultimate authority remains with the Ministry, so rapid or sector-driven innovation remains constrained. According to the ministry, 50 professional curricula were updated in 2024, with a goal of revising 100 by 2025.

Industry involvement is formalised but not decisive. Employers and social partners participate in consultative councils and contribute to occupational standard-setting, but the highly centralised structure reduces their capacity to directly shape curricula. Work-based learning is present, particularly through apprenticeship contracts, which provide opportunities for learners to engage with digital technologies in authentic workplace contexts. However, the translation of these experiences into curricular content remains uneven.

Despite recent efforts to integrate digital skills more effectively across French IVET, disparities remain. These occur across programme types: CAP curricula lag behind Bac Pro and Bac Techno pathways, where digital skills are more consistently embedded in the curriculum. Sectoral differences are also pronounced, as some industries proactively adopt new technologies and adapt teaching practices, while others remain slower to modernise. Territorial disparities persist between urban and rural areas, affecting access to digital infrastructure and resources. Lastly, teacher training in digital pedagogy has expanded in recent years through national and EU-supported initiatives (such as the Digital Strategy for Education 2023-2027, that includes support for teachers' professional development), yet coverage seems to remain uneven, and opportunities to deepen skills for advanced digital teaching are not uniformly available across all IVET pathways. In summary, France illustrates the strengths and limitations of a highly centralised model. National strategies and frameworks provide coherence, visibility, and system-wide benchmarks, while updated Bac Pro curricula show that digital skills can be effectively integrated. However, structural rigidities slow down adaptation, particularly in CAP programmes, where outdated curricula risk leaving students digitally underprepared. The case highlights the need to balance national coherence with mechanisms that allow faster sectoral or regional responsiveness in an era of rapid technological change.

5.6. Croatia

The Croatian IVET system reflects a centralised governance tradition, where curriculum development and approval are managed predominantly by national authorities, with schools and regional actors having limited autonomy. The principal authority is the Ministry of Science and Education (MZO), which defines the strategic direction of IVET, approves curricula, and ensures their compliance with national education laws and frameworks. Additional support and quality assurance are provided by the Agency for Vocational Education and Training and Adult Education (ASOO), created in 2005, which is responsible for the development and organisation of the VET system, and manages the general education component of IVET curricula. Moreover, the Council for VET is a 21-member body coordinating relevant stakeholders' activities and initiates curriculum development and revision. This structure creates a uniform national framework, ensuring comparability of qualifications across the country, but it also constrains responsiveness to emerging labour market needs, including digital skills.

ISCED level 3 IVET in Croatia is offered primarily through vocational secondary schools, which enrol most upper secondary students. These schools provide both three-year programmes, focused on direct labour market entry, and four-year programmes, which allow progression to higher education. Curricula are defined nationally through occupational standards under the Croatian Qualifications Framework (CROQF), and schools have limited flexibility to adapt content. Apprenticeships and employer training periods within regular school-based learning models are also offered in some sectors. The curriculum structure typically combines general education subjects with vocational modules, though the balance differs depending on programme duration and orientation; curricula are adaptable thanks to the modular and outcome-based structure.

In Croatia, there are no specific guidelines for digital skill inclusion in IVET curricula. Rather than a stand-alone element, digital skills and literacy are included across all programmes, usually through ICT-related general subjects that equip students with fundamental skills in computer use, internet navigation, and office software. Even when they are not explicitly mentioned as curriculum units, they are included in the expected learning outcomes of other units. However, the embedding of more advanced or sector-specific skills is limited and highly dependent on the field of study. ICT-oriented programmes, such as those in computer technology or electronics, naturally include more extensive digital components, covering programming, networking, or systems administration. In other sectors, such as hospitality, construction, or health, digital skills are present but less systematically integrated. For instance, while students in tourism may be exposed to digital reservation systems or marketing tools, these elements are not standardised across all schools offering the programme.

The national reports highlight that Croatia has undertaken reforms to modernise VET curricula, partly supported by EU-funded projects and alignment with European frameworks. The Croatian Qualifications Framework (CROQF) provides a structure for defining learning outcomes and aligning them with the European Qualifications Framework. Within this framework, digital skills are recognised as key transversal skills, but their operationalisation in curricula remains underdeveloped. Recent initiatives - such as Croatia's Digital Strategy for

2032 (*Strategija Digitalna Hrvatska za razdoblje do 2032*) or the Strategic Framework for the Digital Maturity of Schools and School Education (*Okvir za digitalnu zrelost škola*), featuring the e-Schools initiative - include pilot projects on e-learning, the introduction of modular curricula in some sectors, and greater emphasis on transversal skills, yet systemic embedding of advanced digital skills is still at an early stage.

Curriculum updating in Croatia is managed centrally and tends to follow periodic cycles rather than continuous renewal. Revisions are typically triggered by policy reforms, EU alignment requirements, sector-specific projects, or the expiration of occupational and qualification standards (which are valid for a five-year period once adopted). The process of curriculum update starts with the revision of the occupational and the qualification standards, and involves consultation with social partners, including employer associations and trade unions, with their role being advisory rather than decisive. The final authority rests with the Ministry and ASOO, which issue official curricula. The slow pace of updates creates challenges in keeping curricula aligned with technological change, particularly in fast-evolving sectors such as ICT or logistics. In some cases, curricula remain in place for more than a decade without substantial revision, limiting their capacity to reflect current workplace realities.

Industry involvement in shaping digital skills is regulated by the CROQF framework and remains limited. While employers are consulted in curriculum development, they have no mandated role related explicitly to digital skills in curricula, and, thus, their participation in curriculum design and update is indirect in terms of digital skill integration.

In terms of accessibility and transparency, Croatia has made progress in publishing curricula online and aligning them with European standards. However, availability is sometimes fragmented, and documentation may not always include detailed learning outcomes related to digital skills. Teachers' capacity to deliver digital content varies across regions, but ongoing professional development and the 2018 curriculum reform (and its 2024–2029 phase) provide a strong foundation for strengthening digital pedagogy. Targeted support for educators and infrastructure, particularly in rural areas, could help ensure that all schools are able to implement the updated curricula effectively and equitably.

The strengths of the Croatian system lie in its coherence, national alignment with the CROQF, and ongoing reform efforts supported by EU funding. At the same time, several challenges remain. Digital skills are recognised in policy and embedded implicitly in curricula, but they are not yet systematically mandated across all programme areas. Updating cycles are centrally controlled and relatively slow, which can limit responsiveness to rapid technological change. Stakeholder engagement is often formal, leaving room to further strengthen industry input in shaping relevant skills. Gaps in teacher training and infrastructure can affect implementation capacity and consistency across regions. As such, while Croatia has made progress in recognising the importance of digital skills, integrating these skills into IVET is still uneven across sectors and schools. Continued reforms, targeted teacher support, and strengthened stakeholder engagement can help ensure that digital competences become a more systematic and widely implemented part of the curriculum.

5.7. Netherlands

The Dutch IVET system is one of the most mature and responsive in Europe, characterised by a strong public–private partnership model and extensive involvement of employers in curriculum design. Governance is shared between the Ministry of Education, Culture and Science (OCW), which sets the legal and financial framework, and the Foundation for cooperation on Vocational Education, Training and the Labour Market (*Samenwerkingsorganisatie Beroepsonderwijs Bedrijfsleven* - SBB), the national organisation responsible for developing and maintaining qualification dossiers. SBB operates through nine sectoral chambers (*sectorkamers*), each representing a broad segment of the labour market, and market segment groups that bring together employers, unions, and educators to define occupational competences. While national qualification dossiers are binding and cover curricula nationally, the actual IVET curricula are developed at the institutional level, by VET providers.

At ISCED level 3, IVET is provided through the system of Secondary vocational education *(middelbaar beroepsonderwijs* - MBO), covering levels 2, 3, and 4. Programmes can be delivered via two routes: the school-based pathway (*beroepsopleidende leerweg* - BOL), which combines classroom learning with internships, and the work-based pathway (*beroepsbegeleidende leerweg* - BBL), where learners are employed for most of the week and attend school one day. Both routes are offered by regional training centres (ROCs), green and agricultural training centres (AOCs), and specialised vocational schools *(vakscholen)*. All programmes are based on national qualification dossiers, which define the competences required for a given qualification and are binding for all providers. Qualification dossiers contain a basic component, common to all sectors, and a profile component, defining the occupational learning outcomes for specific sectors and professions. Within this framework, providers retain significant autonomy in delivery, pedagogy, and the use of optional modules.

Although there is not a single overarching national strategy for digital skill integration in VET curricula, 2022 Netherlands Digitalisation Strategy (*Nederlandse Digitaliseringsstrategie* - NDS) brought a broader focus on digital literacy and has influenced sectors for curricular design. Digital skills are embedded in multiple ways. First, transversal digital literacy is integrated into the core components of many qualification dossiers, resulting in high standardisation and consistency across sectors and VET institutions. Second, sector-specific digital applications are included in profile components, for example in logistics (digital supply chain management), healthcare (electronic patient records and telecare), or construction (digital design and BIM systems). Third, optional components (*keuzedelen*) provide space for innovation and advanced skills, allowing institutions to introduce electives such as generative AI, drone operations, livestreaming, or digital helpdesk support. These components enable rapid curricular adaptation, ensuring that learners in dynamic sectors acquire cutting-edge competences even before they are formally embedded in the core dossiers.

Recently, several national initiatives have reinforced digital skill integration. The DIGIT-mbo programme provides modular resources for teaching digital skills across multiple sectors, covering basic literacy, online collaboration, and advanced applications. Its design allows integration as standalone modules or within existing subjects. In parallel, the Npuls programme, funded through the National Growth Fund, supports institutional digital strategies,

teacher training, and the development of digital learning environments. These initiatives have strengthened the systemic integration of digital skills while also promoting pedagogical innovation.

Curriculum updating in the Netherlands is responsive and demand-driven and relies on continuous monitoring. Qualification dossiers are typically reviewed every three to five years, though fast-moving sectors may undergo more frequent revisions. Proposals for updates are initiated at the market segment level, where employers and educators identify changing occupational requirements. Proposals are validated by the sectoral chamber, reviewed by the SBB board, and then transmitted to and approved by the Ministry of Education. Once validated, the updated dossiers are binding for all MBO providers. This process ensures national consistency while remaining responsive to sectoral signals.

Industry involvement in shaping digital skills is extensive. Employers not only participate in the design of qualification dossiers but also provide work placements, which are mandatory in both BOL and BBL routes. Companies recognised as learning workplaces by SBB are directly involved in delivering digital training, exposing learners to sector-specific technologies in real contexts. This dual engagement -through curriculum design and work-based learning- ensures that digital skills are both formally defined and practically experienced.

Despite the relevant high levels of digital skill integration, digital literacy is still not a compulsory core component for all curricula. This means that digital skills are most often included through optional components or electives, which leads to an uneven and inconsistent implementation in IVET programmes. Moreover, because optional components are selected by institutions and not mandated nationally, implementation varies significantly across institutions and regions. In tech-driven regions VET providers may be more likely to experiment with VR, 3D printing, digital simulation, and AI-related tools, that is advanced digital technologies. In contrast, schools in rural areas or less digitalised sectors may focus more on other skills, for example agriculture related. Healthcare and green sectors are also slower to adopt advanced tools.

In sum, the Netherlands demonstrates how a partnership-based governance model and flexible curriculum structure can promote systematic yet adaptable integration of digital skills. The combination of binding qualification dossiers and optional keuzedelen allows both stability and innovation, while strong employer engagement guarantees labour market relevance. Remaining challenges relate to equity of access and consistency of implementation across institutions, regions, and sectors. Moreover, while providers enjoy autonomy, not all have equal capacity to invest in teacher training or infrastructure. Nevertheless, the Dutch system provides a clear example of how bottom-up innovation can complement national frameworks in advancing digital skills in IVET.

5.8. Finland

The Finnish IVET system is widely recognised for its learner-centred, competence-based approach, which provides significant flexibility to both providers and learners. It is the example of a decentralised but highly standardised education system, in which governance is coordinated nationally by the Ministry of Education and Culture and the Finnish National

Agency for Education (EDUFI), which is responsible for the national qualification requirements that define the structure, objectives, and assessment criteria for all vocational programmes, develops quality management in VET, and supports VET providers. At the same time, the latter have extensive autonomy in organising delivery, choosing pedagogical methods, and tailoring programmes to local and sectoral needs. This model combines national coherence with local flexibility, supported by systematic anticipation of labour market developments.

At ISCED level 3, IVET is delivered mainly through vocational institutions offering qualifications at EQF levels 4 and 5. Programmes are modular and based on learning outcomes rather than fixed study durations. Learners can progress at their own pace, and prior learning can be recognised and accredited. All qualifications include compulsory common units (such as communication, mathematics, and digital skills), vocational modules specific to the field of study, and optional modules that allow for individual specialisation. The two latter types of units make up for over 80% of total competence points. Learners are also required to create a personal competence development plan (PCDP) as part of the overall personalisation process of the VET studies.

Digital skills in Finland are embedded systematically across all qualifications. Since the 2018 reform, digital skills have been defined as part of the key transversal skills that every learner must acquire, regardless of their field. More recently, Finland's 2023 'Policies for the Digitalisation of Education and Training until 2027' (*Kasvatuksen ja koulutuksen digitalisaation linjaukset 2027)* report and the 2022 'Government report: Finland's Digital Compass' (*Valtioneuvoston selonteko: Suomen digitaalinen kompassi*) mandate the integration of digital tools and skills across all education levels. In addition to general digital literacy skills present in all curricula, sector-specific qualifications integrate relevant digital applications, such as digital diagnostics in automotive maintenance, CAD in construction, or digital health records in healthcare. This dual approach ensures that learners acquire both transversal literacy and specialised skills tailored to their chosen occupation.

The Finnish system benefits from a strong tradition of foresight and anticipation. The National Forum for Skills Anticipation, established in 2017, conducts regular medium- and long-term forecasts of skills and labour market needs, which inform the revision of qualification requirements. These analyses are carried out in collaboration with sectoral committees, employers, trade unions, and education providers. As a result, digital skills are continuously monitored and integrated where necessary.

Curriculum updating in Finland is continuous rather than cyclical since 2018. Qualification requirements are reviewed regularly, and revisions can be introduced whenever labour market changes or policy priorities demand it. EDUFI plays a central role in this process, working closely with education providers, teachers, and employers' and employee's organisations. Qualification requirements and curricula revisions are based on the skills anticipation system, fed with relevant information by the National Forum for Skills Anticipation. Providers are then responsible for implementing updated requirements in their programmes, which they can adapt to local contexts. This system allows for rapid integration of new skills, ensuring that curricula remain current and relevant. All IVET curricula were renewed by the end of 2025 and previously announced new core curricula came into force in July 2025. These developments were largely based on the Digitalisation in VET Network project (*Digitalisaatio ammatillisessa*

koulutuksessa -verkosto) launched in 2022, as well as a 2023 guide titled 'Digital skills and competences in VET – a guide to formulating competences' (*Digitaalinen osaaminen ammatillisessa koulutuksessa, opas osaamisen sanoittamiseen).*

Industry involvement is extensive and institutionalised. Employers participate in the National Forum for Skills Anticipation and in sectoral working-life and business and industry committees, where they help define learning outcomes and occupational standards. They also play a major role in work-based learning, where learners acquire digital skills directly in workplace settings. This dual involvement ensures that digital skills are both defined systematically at the policy level and experienced practically in authentic contexts.

Despite the robust system for digital skill integration in Finland, guaranteed by a decentralised yet structured system for development and updating of IVET curricula, disparities persist. Urban regions and larger institutions tend to have more advanced digital infrastructure; on the contrary rural or smaller IVET providers often lack the infrastructure or the staff capacity to implement advanced digital training. Moreover, sectoral disparities are also present, with some manual professions treating digital literacy as peripheral rather than core skills. For example, media, ICT, and technical design curricula are 'digital-intensive' curricula, where work is often carried out in a digital environment. Sectors that are less digital-intensive include more traditional hands-on fields such as arts and crafts, massage therapy, catering, cleaning services, and construction. Quality assurance in the Finnish VET system is multilayered: VET providers conduct self-evaluation and peer reviews, while external evaluations are carried out by the Finnish Education Evaluation Centre (FINEEC). Teacher competence varies, and while continuing professional development is encouraged, not all educators are equally prepared to deliver advanced digital pedagogy.

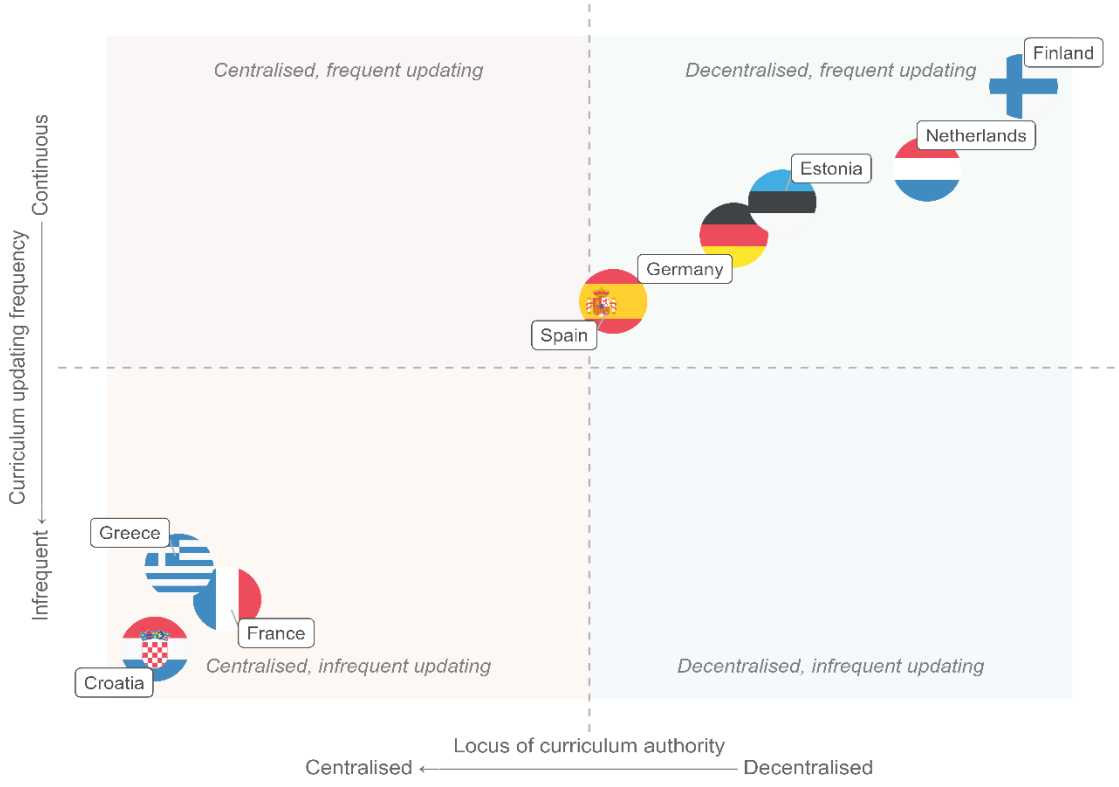
Overall, Finland represents a benchmark case of systemic digital integration in IVET. Its competence-based model, continuous updating mechanisms, and strong stakeholder involvement create a coherent framework that embeds digital skills across all qualifications. The modular and competence-based structure allows for flexible adaptation, and foresight mechanisms ensure continuous updating. At the same time, challenges remain. Regional disparities in digital infrastructure persist, particularly in remote areas. Moreover, the rapid pace of technological change poses an ongoing challenge, requiring constant vigilance to ensure curricula remain up to date. The Finnish case demonstrates how systemic guarantees, supported by foresight and provider autonomy, create the conditions for effective and equitable digital skill development across the IVET system.

Chapter 6.
Comparative analysis

The comparative analysis of the eight national cases shows that differences in the integration of digital skills into IVET curricula are not simply the result of policy ambition or resource availability but are structurally embedded in institutional arrangements governing curriculum design, updating, and implementation. While all countries formally recognise the importance of digital skills, the ways in which these are embedded vary systematically along several interrelated dimensions. These include governance structures, curriculum integration modalities, updating mechanisms, stakeholder involvement, and implementation capacity. Examining these dimensions together reveals distinct institutional logics that shape both the scope and the limits of digital curriculum reform.

Figure 3 plots the eight countries along two dimensions that emerged as the most structurally consequential across the national cases: locus of curriculum authority and curriculum updating frequency. The distribution reveals a clear clustering: countries with centralised authority tend also to exhibit lower updating frequency, while those with more distributed governance structures are more likely to sustain continuous or demand-driven revision processes. Spain occupies an intermediate position, reflecting an ongoing transition towards a more accelerated updating model under recent legislative reform.

Figure 3. Locus of curriculum authority and updating frequency



Source: Authors' elaboration.

A first cross-cutting pattern concerns the relationship between curriculum governance and responsiveness to technological change. Centralised systems – most notably Greece, France, and Croatia – are characterised by strong national steering, with ministries retaining primary authority over curriculum content development and revision. In these systems, digital skills are typically embedded through nationally defined curricula that apply uniformly across institutions. This approach ensures formal coherence, transparency, and equal recognition of qualifications, which are particularly important in IVET systems that serve as gateways to regulated occupations and labour market entry. However, the same features that ensure coherence also constrain adaptability. Curriculum revision is often tied to legislative cycles, ministerial decrees, or comprehensive reform packages, resulting in long intervals between updates. Consequently, digital skills tend to be integrated in discrete reform moments rather than through continuous adaptation, increasing the risk that curricula lag behind technological developments.

Partnership-based and decentralised systems – such as those of Germany, Estonia, the Netherlands and Finland– display a different institutional logic. In these systems, employers, trade unions, and sectoral bodies play a decisive role in defining occupational standards and initiating curriculum updates. This distribution of authority enables closer alignment with labour market developments and allows emerging digital skills to be integrated more rapidly in technologically dynamic sectors. At the same time, increased autonomy comes at the cost of greater heterogeneity. The pace and depth of digital skill integration vary across sectors depending on employer engagement, economic structure, and institutional capacity. The comparative evidence thus confirms that governance arrangements shape not only the speed of reform but also its internal consistency. Rather than a simple dichotomy between ‘good’ and ‘bad’ governance models, the findings point to a structural trade-off between coherence and adaptability that is particularly salient in digital domains.

A second key dimension concerns the modalities through which digital skills are integrated into IVET curricula. Across the eight countries, three broad modalities can be distinguished: transversal integration of digital components, sector-specific embedding of digital skills, and elective or pilot-based integration of digital components. Systems that have introduced compulsory transversal digital components provide a baseline guarantee that all learners acquire a minimum level of digital skills, regardless of occupational field. Germany, Spain and Finland exemplify this approach, embedding digital skills as mandatory elements across programmes. From a comparative perspective, transversal integration appears particularly effective in mitigating risks of digital exclusion, as it reduces dependence on sectoral priorities or institutional initiative.

However, transversal integration alone does not ensure occupational relevance. Sector-specific embedding remains essential for aligning curricula with concrete work processes and technologies. All eight systems rely to some extent on sectoral integration, but the depth and consistency of such embedding vary markedly. In decentralised systems, sectoral bodies can update curricula in response to technological change, leading to advanced digital integration in fields such as ICT, engineering, and logistics. Yet this responsiveness is uneven, as sectors with slower technological change or weaker employer organisation tend to lag behind. In

centralised systems, sectoral differentiation is often less pronounced, and digital skills may remain generic or unevenly articulated across programmes.

Elective and pilot-based integration of digital components in curricula constitutes a third pathway, allowing innovation without system-wide reform. The Netherlands' use of optional curriculum components and Greece's reliance on experimental schools illustrate how emerging digital skills can be introduced flexibly. While such approaches foster experimentation and rapid response, they also concentrate opportunities among a subset of learners and institutions. Without explicit mechanisms for scaling and diffusion, elective and pilot-based integration risks reinforcing existing inequalities rather than addressing them. The comparative analysis thus highlights that integration modality is not a neutral design choice but has direct implications for equity and coverage.

Curriculum updating mechanisms form a third axis of comparison that cuts across governance models. Systems characterised by continuous or responsive updating – such as Germany, Estonia, the Netherlands, and Finland– are structurally better positioned to integrate digital skills incrementally as technologies evolve. In these systems, curriculum change is not confined to infrequent reform cycles but is supported by ongoing revision processes linked to labour market analysis, sectoral consultation, and skills anticipation. This allows for gradual adaptation while preserving overall system stability. Importantly, continuous updating does not necessarily imply constant overhaul; rather, it enables targeted revisions that integrate new competences without destabilising existing qualifications.

By contrast, systems relying on periodic or slow revision cycles face greater risks of misalignment. In France and Croatia, some curricula remain unchanged for extended periods, limiting their relevance in rapidly digitalising sectors. Greece exhibits a similar pattern in mainstream IVET pathways, where innovation is often confined to experimental tracks. Spain represents a partial exception among centralised systems, having accelerated digital integration through comprehensive legislative reform. Nevertheless, even in this case, the translation of reform into classroom practice depends on regional capacity and implementation timelines, illustrating that accelerated reform does not automatically translate into rapid change on the ground.

The role of social partners emerges as another critical mechanism shaping digital integration. In Germany, Estonia, the Netherlands, and Finland employers' organisations and trade unions are directly involved in defining occupational standards and revising curricula. This involvement enhances labour market relevance and facilitates the integration of sector-specific digital skills. It also strengthens the link between school-based learning and workplace training, particularly in apprenticeship-based systems. However, strong social partner involvement can also amplify sectoral disparities, as sectors with strong employer organisation and technological dynamism advance more rapidly than others.

In more centralised systems, social partner involvement is typically consultative rather than decisive. While formal consultation mechanisms exist in Greece, Spain, France, and Croatia, final authority rests with ministries. As a result, employer input does not always translate into curricular change, particularly where reform processes are slow or politically constrained. The comparison suggests that stakeholder involvement enhances

responsiveness only when it is institutionally embedded in decision-making processes rather than confined to advisory roles.

Sectoral disparities represent one of the most consistent findings across the eight countries. Regardless of their governance model, ICT, engineering, and technology-intensive programmes exhibit more advanced integration of digital skills than service-oriented or traditional fields such as hospitality, personal care, or agriculture. This pattern reflects differences in technological intensity, employer demand, and occupational identity. Sectors undergoing rapid digital transformation articulate skill needs more clearly and exert stronger pressure for curriculum reform. Without transversal guarantees or targeted policy intervention, these disparities risk becoming entrenched within IVET systems.

Regional and institutional disparities further complicate the picture. Across countries, urban regions and large training providers are generally better equipped to implement digital curricula than rural areas and small institutions. Differences in infrastructure and access to industry partnerships contribute to uneven learning opportunities. In decentralised systems, institutional autonomy can amplify these differences; in centralised systems, limited local capacity can undermine national reforms. The comparison shows that curriculum design alone is insufficient to ensure equitable outcomes if implementation conditions vary widely.

Teacher and trainer capacity cuts across all comparative dimensions. Across all eight countries, limitations in teacher training and professional development emerge as a common bottleneck. Even where curricula formally include digital skills, implementation may remain superficial if educators lack confidence, resources, pedagogical support, or appropriate training. This finding aligns with previous analytical work by Cedefop, which has highlighted the central role of teachers and trainers in mediating curriculum reform and translating policy intent into learning practice (Cedefop, 2022b). It is further corroborated by the preliminary findings of Cedefop's European Vocational Teacher Survey (EVTS) pilot, which draws on responses from 735 teachers across 23 EU Member States and identifies teacher professional development as strongly shaped by informal and self-directed learning, supportive organisational environments, and favourable working conditions, rather than by formal training alone (Psifidou et al., 2026). Notably, the EVTS pilot finds that engagement with digital tools and practices is among the strongest correlates of professional development, underscoring the importance of sustained investment in teachers' digital skills and school-level digital infrastructure. In company-based training, similar challenges arise for in-company trainers, particularly in small and medium-sized enterprises with limited resources.

Table 2 provides a comparative overview of the eight countries across five key dimensions: governance model, integration modality, curriculum updating mechanism, skills anticipation, and social partners' involvement. Taken together, the profiles illustrate the diversity of institutional arrangements through which digital skills are formally embedded in IVET curricula and point to the structural conditions that facilitate or constrain more systematic integration.

Table 2. Comparative overview of digital skills integration frameworks in IVET

Country	Governance model	Integration modality	Updating mechanism	Skills anticipation	Social partner role
Germany	Decentralised but federally coordinated	Transversal (compulsory module) + sector-specific	Continuous (uneven by sector)	Moderate	Decisive; initiates all revisions
Estonia	Guided autonomy	Transversal + sector-specific; tiered (generic/ field-specific/ ICT)	Responsive (every 5yr or earlier)	Strong (OSKA)	Decisive; direct in occupational standards
Greece	Highly centralised	Basic transversal in mainstream; Pilot/elective (PEPAL)	Periodic (every 5-7 yr)	Weak	Advisory; stronger in experimental schools
Spain	National coherence but regional autonomy	Transversal (compulsory) + sector-specific + specialisation courses	Periodic + accelerated	Moderate (INCUAL)	Tripartite; consultative in practice
France	Highly centralised	Transversal (Bac Pro); weak in CAP	Decree-based, responsive / slow	Weak	Consultative (strengthened post-2018)
Croatia	Centralised	Transversal (implicit); sector-specific limited	Periodic (every 5yr) / slow	Weak	Advisory only
Netherlands	Decentralised and partnership-based	No compulsory transversal; sector-specific + optional (keuzedelen)	Responsive (3–5 yr + demand-driven)	Moderate (SBB)	Decisive; designs qualification dossiers
Finland	Decentralised	Transversal (compulsory) + sector-specific	Continuous	Strong (National Forum & EDUFI)	Decisive; sectoral committees

Source: Authors' elaboration.

The comparative analysis demonstrates that digital skills integration in IVET is shaped by interacting institutional mechanisms rather than isolated policy choices. Governance structures influence responsiveness and coherence; integration modalities affect coverage and relevance; updating mechanisms condition adaptability; stakeholder involvement shapes labour market alignment; and implementation capacity determines whether formal provisions translate into practice. No system resolves all trade-offs. Centralised systems struggle with speed, decentralised systems with consistency, and all systems face challenges related to equity and capacity.

The comparative evidence therefore points to the importance of institutional complementarity. Transversal digital skills can provide a common baseline, while sector-specific embedding ensures occupational relevance. Responsive updating mechanisms and skills anticipation can mitigate risks of obsolescence, while strong but coordinated stakeholder involvement can enhance relevance without sacrificing coherence.

Teacher competence in digital skills emerges as a persistent structural concern across the eight countries examined, and one that the broader European policy landscape has not

left unaddressed. Since the COVID-19 pandemic, significant national and European initiatives have been undertaken to strengthen VET teachers' digital capacities. Emergency remote teaching during the pandemic functioned as a catalyst, accelerating investment in digital infrastructure, online learning platforms, and emergency upskilling programmes across virtually all Member States. These efforts were subsequently consolidated and extended through targeted measures under the Digital Education Action Plan (2021–2027), which explicitly calls for strengthening educators' digital competences and improving the digital readiness of schools and training institutions. At national level, countries have invested in dedicated teacher digital upskilling programmes, revised initial teacher education requirements, and expanded access to self-assessment tools such as SELFIE for Teachers, which provides a structured framework for diagnosing and addressing digital competence gaps among VET educators (European Commission, 2023).

The challenge of artificial intelligence in VET teaching deserves particular attention in this context. The rapid diffusion of AI tools into educational and professional settings has added new urgency to questions of teacher preparedness. The European Commission's Guidelines on the ethical use of artificial intelligence and data in teaching and learning for educators (European Commission, 2026) provide a framework for responsible AI use in educational contexts, emphasising transparency, fairness, and the importance of educators being equipped to guide learners in the critical and ethical use of AI. For VET specifically, where learners are preparing for labour markets in which AI is increasingly embedded in work processes, teachers need not only foundational AI literacy but also the capacity to contextualise AI tools within occupational and sectoral realities. How to harness AI's potential while maintaining the human core of learning – critical thinking, ethical judgement, hands-on skills and social interaction – is another challenge that VET teachers and trainers must address and be prepared for (Psifidou, 2026b). Preliminary findings from Cedefop's European Vocational Teacher Survey (EVTS) pilot indicate that around a third of VET teachers feel insufficiently prepared to evaluate the ethical risks and potential harms associated with AI use, and that 57% expect intelligent systems to perform parts of teachers' work within the next decade – a finding that reflects both the pace of change and the depth of uncertainty teachers face (Psifidou et al., 2026).

It should be noted that this paper focuses on the design and governance of written digital skills curricula; the implementation of these curricula and the learning outcomes achieved by students fall outside its primary scope. Nevertheless, teacher competences in digital and AI-related skills represents a critical enabling condition for the effectiveness of any curriculum reform, and the gap between curricular ambition and classroom reality remains a concern that national systems will need to address through sustained, targeted investment in professional development alongside curriculum design.

This expanded comparative perspective serves as a bridge between the country case studies and the discussion that follows. It highlights how structural features of IVET systems influence digital curriculum reform and explains why similar policy objectives produce divergent outcomes across national contexts. The next Chapter situates these findings within broader debates on VET governance, digital transformation, and inclusion, and explores their implications for policy design and system development.

Chapter 7.
Conclusions and policy messages

This paper set out to examine how digital skills are embedded in initial vocational education and training (IVET) curricula across eight European countries, drawing on harmonised national contextual reports prepared within a common analytical framework. Drawing on comparative evidence, these preliminary findings demonstrate that although digital skills have become a shared policy priority across Europe, their curricular integration remains highly uneven in scope, depth, and coherence. These differences are not accidental. Rather, they reflect structural features of IVET systems, including governance arrangements, curriculum updating mechanisms, stakeholder involvement, and implementation capacity. Understanding these structural determinants is essential for drawing policy-relevant conclusions.

What emerges clearly from the comparative analysis is that digital skill integration in IVET is fundamentally shaped by **institutional processes and structures**, along with the inherent trade-offs they necessitate. Centralised systems tend to prioritise coherence, standardisation, and equity in qualification design, but often struggle to adapt curricula rapidly to technological change. Decentralised or partnership-based systems, by contrast, are more responsive to labour market signals and technological developments, but face challenges related to uneven implementation across sectors, regions, and institutions. These trade-offs are intrinsic to IVET governance and cannot be effectively managed through isolated reforms. Digitalisation amplifies these tensions because it accelerates skill obsolescence and places greater pressure on curriculum systems to adapt more quickly than traditional revision cycles allow. Among the eight countries examined, France, Croatia, and Greece illustrate the coherence that centralised systems can achieve – but also their slow pace of adaptation: some CAP programmes in France have not been revised for over fifteen years. Germany, Estonia, the Netherlands and Finland demonstrate how governance models that distribute authority across social partners and sectoral bodies are better positioned to integrate emerging digital skills while also maintaining system-wide consistency and flexibility.

Beyond governance arrangements, **the modalities through which digital skills are embedded** constitute an equally important dimension. The analysis shows that systems relying solely on transversal digital skills risk superficial coverage, while systems relying primarily on sector-specific embedding tend to produce fragmented and unequal outcomes. Transversal integration plays a crucial role in guaranteeing a minimum level of digital literacy for all learners and reducing the risk of digital exclusion. Sector-specific integration is equally essential for ensuring occupational relevance and alignment with workplace technologies. The most robust approaches combine both dimensions but achieving this requires strong coordination mechanisms and sufficient institutional capacity. Hybrid models are therefore more effective but also more demanding in terms of governance and resources. Spain's recent reform – which introduced a compulsory transversal digitalisation module across all intermediate VET programmes while preserving sector-specific content – illustrates this combined approach in practice. Germany's model offers a similar example: a universal

'digitised world of work' module applies to all apprenticeships, while occupation-specific digital content is defined separately in individual training regulations.

Governance and embedding modalities alone, however, cannot account for the pace at which digital skills enter curricula. **Curriculum updating and skills anticipation mechanisms** prove equally decisive. Digital skill integration is not a one-time reform but an ongoing process that requires continuous monitoring and adaptation. Systems with institutionalised skills anticipation mechanisms and responsive updating processes are better positioned to integrate emerging digital skills in a timely manner. Where foresight exists but is weakly linked to curriculum governance, digital skill integration tends to be reactive and uneven. This finding highlights that foresight is only effective when it is embedded in decision-making structures that translate evidence into curricular change. Estonia's OSKA system is the clearest example among the eight countries of foresight embedded in governance: sectoral labour market analyses feed directly into occupational standards, which in turn trigger curriculum revisions. Greece, conversely, has national strategies and reform ambitions but limited formal linkage between skills anticipation and the curriculum revision process, illustrating opportunities to strengthen these mechanisms for faster and more systematic integration of emerging digital competences.

The role of social partners emerges from the analysis as both an enabler and a source of differentiation across systems. Strong employer and union involvement enhances labour market relevance and supports the integration of occupation-specific digital skills. However, it can also reinforce sectoral disparities if technologically advanced sectors move ahead more rapidly than others. Stakeholder involvement therefore needs to be complemented by coordination mechanisms that ensure system-wide coverage and prevent digital skill provision from becoming dependent on sectoral dynamism alone. In Germany and the Netherlands, strong employer involvement has driven advanced digital integration in ICT, engineering, and logistics – but service and craft sectors have lagged behind, illustrating how sector-specific dynamism without cross-sectoral coordination can widen rather than narrow inequalities. Finland's National Forum for Skills Anticipation, with its broad multi-stakeholder representation, offers a model of how coordination mechanisms can counteract this tendency and ensure more equitable access to digital skills across sectors.

At this stage of qualitative analysis and literature review, **persistent sectoral disparities** represent a consistently observed challenge across the eight countries examined, although this conclusion is still to be confirmed by the forthcoming NLP analysis. Across all eight countries, digital skills remain more advanced in ICT- and engineering-related programmes than in service-oriented or traditional fields, despite an overall trend of digital skills integration in general curricula at the foundational level. Moreover, regional and institutional disparities further compound these differences, with urban areas and large providers generally better equipped than rural regions and small institutions. These patterns suggest that, without targeted intervention, digitalisation risks reinforcing existing inequalities within IVET rather than mitigating them. From a policy perspective, this underscores the need for explicit equity-oriented measures and targeted support to bridge regional, sectoral, and institutional gaps.

Teacher and trainer capacity constitutes a cross-cutting constraint affecting all systems. Regardless of curriculum design or governance model, the effective integration of digital skills

depends on educators' ability to interpret curricula, adopt digital pedagogy, and integrate technology into vocational learning environments. The findings confirm that digitalisation reforms in IVET are seldom accompanied by appropriate provisions for dedicated training or upskilling for teachers and trainers asked to integrate digital elements in the classroom or teach digital literacy. This aligns with broader evidence from Cedefop's work on VET teachers and trainers (Cedefop, 2022b; Psifidou et al., 2026), which consistently highlights that curriculum reform without parallel investment in human capacity risks remaining symbolic rather than transformative. Strengthening teacher capacity is therefore a precondition for meaningful, scalable, and sustainable digital skills integration.

These findings translate into the following policy considerations at both EU and national levels:

(a) digital skill integration in IVET requires systemic guarantees rather than reliance on pilots, electives, or isolated initiatives. Transversal digital skills should be embedded across all IVET programmes to ensure a common baseline for all learners, while allowing room for sector-specific differentiation.
(b) curriculum updating mechanisms need to become more responsive. This does not necessarily imply constant reform, but rather the introduction of flexible procedures that allow incremental updates informed by skills anticipation and labour market intelligence.
(c) stakeholder involvement should be strengthened and better coordinated to ensure efficiency, coherence, and equity across sectors.
(d) policy attention should extend beyond curriculum design to implementation conditions. Investments in infrastructure, learning environments, and digital pedagogy are essential for translating formal curriculum provisions into meaningful learning outcomes. Particular attention should be paid to disadvantaged regions, small providers, and sectors with lower digital intensity, where capacity constraints are most pronounced.
(e) teacher and trainer professional development should be treated as a core component of digital curriculum reform rather than as a complementary measure. Continuous upskilling in both digital competences and digital pedagogy is indispensable in a context of rapid technological change.

At EU level, these preliminary findings reinforce well-established knowledge on the conditions for effective curriculum reform, while highlighting the specific challenges of integrating digital skills in IVET, where rapid technological change places particular pressure on curriculum systems. European frameworks such as DigComp and ESCO provide important reference points, but their impact depends on how they are operationalised within national IVET systems. EU-level support can play a critical role in strengthening skills anticipation, supporting teacher training, and addressing disparities through targeted funding and knowledge exchange. At national level, policymakers face the challenge of balancing stability with adaptability, ensuring coherence while enabling innovation, and promoting digitalisation without exacerbating inequalities.

In conclusion, the integration of digital skills into IVET curricula is a complex, ongoing, and institutionally mediated process. The eight national cases examined in this paper illustrate both progress and persistent gaps, with results still awaiting further validation and refinement through NLP-based analysis. Digital skills are firmly embedded in policy discourse, yet their

curricular integration remains uneven and mediated by structural constraints. Addressing these challenges requires moving beyond isolated reforms towards coordinated, capacity-aware, and equity-oriented strategies. IVET systems occupy a pivotal position at the intersection of education and labour markets. Ensuring that they provide meaningful and inclusive digital skills is therefore not only an educational objective but a broader economic and social imperative.

The time has come to move from commitment to implementation, ensuring that digital skills policies translate into systematic, scalable, and equitable change across IVET systems. The priority must now be implementation capacity, accountability, and system-level coherence to ensure that no learner or sector is left behind. Ultimately, the credibility of digital skills policy and curriculum reform will be judged not by ambition alone, but by its tangible impact on learners, educators, and labour market outcomes, and, by extension, on the ability of IVET systems to remain relevant in rapidly transforming economies and societies.

List of abbreviations

AI	Artificial intelligence
ARC	Athena Research Center
ASOO	Agency for Vocational Education and Training and Adult Education (Croatia)
Bac Pro	Baccalauréat Professionnel (France)
BBL	Beroepsbegeleidende leerweg — work-based pathway (Netherlands)
BIBB	Federal Institute for Vocational Education and Training (Germany)
BOL	Beroepsopleidende leerweg — school-based pathway (Netherlands)
CAP	Certificat d'Aptitude Professionnelle (France)
CNCP	Catálogo Nacional de Cualificaciones Profesionales (Spain)
CRCN	Cadre de Référence des Compétences Numériques (France)
CROQF	Croatian Qualifications Framework
DigComp	Digital Competence Framework for Citizens
DNE	Direction du Numérique pour l'Éducation - Digital Education Directorate (France)
DVS	Department for VET and Skills (Cedefop)
DYPA	Public Employment Service (Greece)
EDUFI	Finnish National Agency for Education
EHIS	Estonian Education Information System
EOPPEP	National Organisation for the Certification of Qualifications and Vocational Guidance (Greece)
EPAL	Vocational Upper Secondary School (Greece)
EPAS	Apprenticeship School (Greece)
EQF	European Qualifications Framework
ESCO	European Skills, Competences, Qualifications and Occupations classification
ESK	Vocational Training School (Greece)
EstQF	Estonian Qualifications Framework
EU	European Union
EVTS	European Vocational Teacher Survey
FINEEC	Finnish Education Evaluation Centre
ICT	Information and communications technology
IEP	Institute of Educational Policy (Greece)
INCUAL	National Institute of Qualifications (Spain)
ISCED	International Standard Classification of Education

IVET	Initial vocational education and training
KMK	Standing Conference of the Ministers of Education and Cultural Affairs (Germany)
KSEEK	Central VET Council (Greece)
MBO	Middelbaar beroepsonderwijs — secondary vocational education (Netherlands)
MEFP	Ministry of Education and Vocational Training (Spain)
NLP	Natural language processing
OCW	Ministry of Education, Culture and Science (Netherlands)
OSKA	Estonian labour market monitoring and future skills forecasting system
PCDP	Personal competence development plan (Finland)
PEPAL	Experimental Vocational Upper Secondary School (Greece)
PEPAS	Experimental Apprenticeship School (Greece)
PIX	French digital skills self-assessment and certification platform
SBB	Samenwerkingsorganisatie Beroepsonderwijs Bedrijfsleven (Netherlands)
SELFIE	Self-reflection on Effective Learning by Fostering Innovation through Educational technology
SSPAE	Regional Councils for Linking VET with Employment (Greece)
VET	Vocational education and training
YPAITHA	Ministry of Education, Religious Affairs and Sports (Greece)

References

Cedefop. (2012). *Curriculum reform in Europe: The impact of learning outcomes.* Publications Office of the European Union. https://doi.org/10.2801/13194

Cedefop. (2015). *Vocational pedagogies and benefits for learners: practices and challenges in Europe*. Publications Office. https://data.europa.eu/doi/10.2801/294434

Cedefop. (2018). *The changing nature and role of vocational education and training in Europe.* Volume 4, Changing patterns of enrolment in upper secondary initial vocational education and training (IVET) 1995-2015. Publications Office of the European Union. https://data.europa.eu/doi/10.2801/45684

Cedefop. (2020). *Vocational education and training in Europe, 1995-2035: Scenarios for European vocational education and training in the 21st century.* Publications Office of the European Union. https://data.europa.eu/doi/10.2801/794471

Cedefop. (2021). *Digital, greener and more resilient: Insights from Cedefop's European skills forecast.* Publications Office of the European Union. https://data.europa.eu/doi/10.2801/154094

Cedefop. (2022a). *Setting Europe on course for a human digital transition: New evidence from Cedefop's second European skills and jobs survey*. Publications Office of the European Union. https://data.europa.eu/doi/10.2801/253954

Cedefop. (2022b). *Teachers and trainers in a changing world building up competences for inclusive, green and digitalised vocational education and training (VET): Synthesis report*. Publications Office of the European Union. https://data.europa.eu/doi/10.2801/53769

Cedefop. (2023a). *Skills in transition: The way to 2035.* Publications Office of the European Union. https://doi.org/10.2801/438491

Cedefop. (2023b). *Stemming the tide: Tackling early leaving from vocational education and training in times of crises: Synthesis report of Cedefop/ReferNet survey.* Publications Office of the European Union. https://data.europa.eu/doi/10.2801/757603

Cedefop. (2025a). *Skills empower workers in the AI revolution: First findings from Cedefop's AI skills survey.* Publications Office of the European Union. https://doi.org/10.2801/6372704

Cedefop. (2025b). *The influence of learning outcomes-based curricula on teaching practices.* Publications Office of the European Union. https://doi.org/10.2801/0800596

Cedefop, & ReferNet. (2025). *Timeline of VET policies in Europe* (2024 update) [Online tool]. https://www.cedefop.europa.eu/en/tools/timeline-vet-policies-europe

Cedefop. (2026). *Digital inclusion and well-being*. VET toolkit for tackling early leaving. https://www.cedefop.europa.eu/en/tools/vet-toolkit-tackling-early-leaving/intervention-approaches/digital-inclusion-and-well-being

Cedefop. (2026 forthcoming). *Policy approaches to addressing learner and teacher wellbeing in EU-27+: Insights from national policy monitoring and analysis.* Cedefop insights. Publications Office of the European Union.

Council of the European Union. (2020). *Council Recommendation of 24 November 2020 on vocational education and training (VET) for sustainable competitiveness, social fairness and resilience: 2020/C 417/01.* https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=oj:JOC_2020_417_R_0001

European Commission. (2017a). *DigComp 2.1: The digital competence framework for citizens with eight proficiency levels and examples of use.* Publications Office of the European Union. https://data.europa.eu/doi/10.2760/38842

European Commission. (2017b). *ESCO handbook: European skills, competences, qualifications and occupations.* Publications Office of the European Union. https://data.europa.eu/doi/10.2767/934956

European Commission. (2020). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: European Skills Agenda for sustainable competitiveness, social fairness and resilience.* COM (2020) 274 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52020DC0274

European Commission. (2021). *Digital Education Action Plan 2021-2027.* https://education.ec.europa.eu/focus-topics/digital-education/plan

European Commission. (2023). *SELFIE for TEACHERS – European Education Area.* https://education.ec.europa.eu/selfie-for-teachers

European Commission. (2025a). *Digital skills and jobs*. Shaping Europe's Digital Future. https://digital-strategy.ec.europa.eu/en/policies/digital-skills-and-jobs

European Commission. (2025b). *Guidelines on prohibited artificial intelligence practices established by Regulation (EU) 2024/1689 (AI Act)*. https://digital-strategy.ec.europa.eu/en/library/commission-publishes-guidelines-prohibited-artificial-intelligence-ai-practices-defined-ai-act

European Commission. (2026). *Guidelines on the ethical use of artificial intelligence and data in teaching and learning for educators*. https://op.europa.eu/en/publication-detail/-/publication/f692aa0b-17a7-11f1-8870-01aa75ed71a1/

Eurostat. (2023, December 15). 56% of EU People Have Basic Digital Skills. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20231215-3

Herning Declaration on attractive and inclusive Vocational Education and Training for increased competitiveness and quality jobs 2026-2030. (2025). https://cdn.table.media/assets/briefings/bildung/herning-declaration-eu2025-final-to-be-endorsed-12-september-2025_.pdf

Osnabruck declaration 2020: *On vocational education and training as an enabler of recovery and just transitions to digital and green economies.* (2020). https://www.cedefop.europa.eu/en/content/osnabruck-declaration-2020-vocational-education-and-training-enabler-recovery-and-just-transitions

Papazoglou, M. (2025). *Embracing digital skills in vocational education | European School Education Platform.* https://school-education.ec.europa.eu/en/discover/expert-views/digital-skills-vocational-education

Pouliakas, K., Santangelo, G., & Dupire, P. (2025). *Are artificial intelligence skills a reward or a gamble? Deconstructing the AI wage premium in Europe.* Eurasian Business Review 15, 1091–1128 (2025). https://doi.org/10.1007/s40821-025-00302-0

Pouliakas, K., & Santangelo, G. (2026). *Human-centred digital transitions and skill mismatches in European workplaces*. Publications Office of the European Union. https://doi.org/10.2801/9894877

Psifidou, I. (2025a). *Empowering VET teachers to lead the digital transition*. Cedefop. 2025 Cisco Networking Academy European Partner Conference. https://doi.org/10.5281/zenodo.18539941

Psifidou, I. (2025b). *Strengthening initial teacher education for VET teachers | European School Education Platform*. https://school-education.ec.europa.eu/en/discover/expert-views/strengthening-initial-teacher-education-vet-teachers

Psifidou, I. Papazoglou M., and Pouliakas, K. (2026). *VET teachers at a turning point: Pilot evidence from Cedefop's European Vocational Teacher Survey.* Cedefop working paper. Publications Office of the European Union. http://data.europa.eu/doi/10.2801/1254726

Psifidou, I., & Symeonidis, V. (2025). *Zooming In on Europe's New Push to Empower VET Teachers.* https://www.cedefop.europa.eu/en/blog-articles/zooming-europes-new-push-empower-vet-teachers

Psifidou, I. (2026a). *Generative AI and labour market inclusion: Equaliser or divider for Europe's workforce?* Cedefop. https://www.cedefop.europa.eu/en/blog-articles/generative-ai-and-labour-market-inclusion-equaliser-or-divider-europes-workforce

Psifidou, I. (2026b). Keeping Learning Human in the Age of Generative AI. Cedefop. https://www.cedefop.europa.eu/en/blog-articles/keeping-learning-human-age-generative-ai

Psifidou, I., & Papazoglou, M. (2026). *Clicks, classrooms and care: Nurturing VET teachers' wellbeing and digital skills.* European School Education Platform. https://school-education.ec.europa.eu/en/discover/expert-views/nurturing-vet-teachers-wellbeing-and-digital-skills

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2 – the Digital Competence Framework for Citizens: With new examples of knowledge, skills and attitudes.* Publications Office of the European Union. https://doi.org/10.2760/115376

DIGITAL SKILL INTEGRATION IN IVET CURRICULA

How governance frameworks shape implementation across eight European countries

This paper forms part of a broader research project on mapping digital skills in initial vocational education and training (IVET) curricula using natural language processing (NLP) techniques across eight European countries at ISCED level 3. It draws on eight harmonised national reports, providing qualitative evidence on curriculum governance, updating processes, stakeholder involvement, and strategies for embedding digital skills.

Findings indicate that governance arrangements strongly influence curricular responsiveness. Centralised systems ensure coherence but adapt more slowly to technological change, whereas decentralised or partnership-based systems offer greater flexibility but exhibit uneven implementation across sectors and regions. Integration approaches, vary from transversal curriculum components to sector-specific embedding, producing differences in coverage, depth and consistency. Common challenges include sectoral disparities, institutional capacity constraints, and gaps in teacher preparation for digital pedagogy.

The paper concludes that effectively embedding digital competences in IVET requires coordinated governance, sustained stakeholder engagement, and continuous investment in teacher capacity and learning infrastructure.

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