UPSKILLED

Upskilling for the Educational Technological Transformation

WP2 Development of Competency Matrices

DESK RESEARCH

Project : AI-UpSkillED – 2025-1-ES01-KA220-HED-000355590

Date: November 2025

Version: FIN

Co-funded by the European Union

The "AI-UPskilled" project is co-funded by the European Union. The views and opinions expressed in this resource/document/material are solely those of the author(s) (project partners) and do not necessarily reflect those of the European Union or the Spanish Service for the Internationalisation of Education (SEPIE). Neither the European Union nor the National Agency SEPIE can be held responsible for them.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

AI-UpskillED is a transnational Erasmus+ cooperation partnership (KA2 – Higher education) funded in Spain that addresses the urgent need for ethical, inclusive, and effective integration of Artificial Intelligence (AI) in education. As AI reshapes learning environments, the project is intended to enhance the capacity of education and training systems, including Higher Education, Adult Education, VET, and Youth sectors, to integrate AI responsibly and inclusively in teaching and learning, by empowering institutions, educators, and society with the skills, resources, and collaborations needed for sustainable digital transformation.

Led by the University of the Balearic Islands (UIB) and supported by six partners from Spain, Portugal, Czechia, Cyprus, and Greece, AI-UpskillED intends to develop structured training programs and competency matrices aligned with the European Qualifications Framework (EQF). These outputs foster AI literacy, pedagogical innovation, and compliance with European priorities on digital transformation, green skills, and lifelong learning, while ensuring interoperability through frameworks such as Europass, Microcredentials, and ESCO. The project also responds to regulatory imperatives introduced by the Artificial Intelligence Act (European Parliament & Council, 2024) and integrates principles from DigCompEdu and Ethics Guidelines for Trustworthy AI, ensuring that educators acquire not only technical proficiency but also ethical and legal awareness.

Work Package 2 (WP2) establishes the foundation for these programs by synthesizing evidence from policy, research, and practice into two EQF-aligned competence matrices: EQF Level 4, addressing adult and youth educators and EQF Level 6, targeting higher education professors, and. These matrices articulate learning outcomes across knowledge, skills, and responsibility/autonomy dimensions, embedding principles of accessibility and Universal Design for Learning (UDL). WP2's methodology combines systematic desk research, co-design workshops, persona-based design, AI-powered feedback analysis, and inclusive validation processes to ensure relevance, quality, and transferability across European education systems.

The implications of WP2 extend beyond competency definition. They provide the structural basis for Work Package 3 (WP3), which will transform these matrices into modular training programs and microcredential pathways, enabling formal recognition of AI-related skills through interoperable digital credentials. This alignment with European frameworks ensures portability, supports professional mobility, and promotes lifelong learning opportunities for educators across sectors.

By bridging policy priorities, pedagogical innovation, and ethical governance, AI-UpskillED contributes to a future-ready European Education Area where AI integration enhances learning without compromising equity, transparency, or trust.

DESK RESEARCH INTRODUCTION

The purpose of this desk research is to map existing frameworks, standards, and practices that support the integration of Artificial Intelligence (AI) in education, alongside digital skills development and the implementation of microcredentials. This analysis provides a structured overview of European and national initiatives that enable ethical, inclusive, and pedagogically sound adoption of AI technologies in teaching and learning environments.

The relevance of this work lies in its direct contribution to Work Package 2 (WP2) of the AI-UPSKILLED project, which focuses on designing and validating competence matrices aligned with the European Qualifications Framework (EQF) at levels 4 (Adult Education/VET) and 6 (Higher Education). By synthesizing evidence from policy documents, educational frameworks, and sectoral standards, this research establishes the foundation for defining AI literacy competencies that are interoperable, transferable, and suitable for certification through microcredentials linked to Europass. It lays the ground for the development of two competence matrices: one for EQF4, addressing youth and adult education educators, and another for EQF6, targeting higher education professors.

The scope of this study is deliberately focused on the European Union policy landscape and selected national strategies from Spain, Portugal, Greece, Cyprus, and the Czech Republic. These countries represent diverse educational contexts and regulatory approaches, offering valuable insights for cross-national alignment. The analysis emphasizes frameworks such as DigCompEdu, EQF descriptors, accessibility standards (e.g., WCAG), and ethical guidelines for trustworthy AI, ensuring that the proposed competence matrices integrate principles of transparency, inclusion, and universal design.

In addition, this research considers macro-environmental factors influencing AI adoption in education and applies a PESTEL framework (Political, Economic, Social, Technological, Environmental, and Legal) to analyze factors shaping AI adoption in education. This systemic perspective ensures that the proposed competencies are not only pedagogically relevant but also resilient to regulatory and technological shifts.

Finally, this desk research aims to bridge the gap between regulatory priorities and practical implementation, supporting educators in acquiring the knowledge, skills, and autonomy required for responsible AI integration in education. It also provides the conceptual basis for subsequent project phases, particularly WP3, which will transform these matrices into modular training programs and microcredential pathways aligned with European standards.

2. METHODOLOGY

This desk research was conducted to provide a comprehensive evidence base for the design of competence matrices aligned with EQF levels 4 and 6. The methodology combines systematic document analysis with a structured coding approach to ensure transparency, relevance, and comparability across sources.

The research draws on four main categories of sources:

1. **European policy documents**, including the Digital Education Action Plan 2021–2027 (European Commission, 2020), the Artificial Intelligence Act (European Parliament & Council, 2024), the European Qualifications Framework (EQF) (European Commission, 2017), the DigCompEdu framework (European Commission, 2018), the Europass digital credential system (European Commission, 2023), and the Council Recommendation on a European approach to microcredentials (Council of the European Union, 2022). These documents provide the regulatory and strategic context for competence development and recognition.

2. **National strategies from Spain, Portugal, Greece, Cyprus, and the Czech Republic**, which outline country-specific priorities for AI adoption and digital education. Examples include Spain's National AI Strategy and Royal Decree 272/2022 on lifelong learning, Portugal's INCoDe.2030 and AI Portugal 2030, Greece's National Digital Strategy 2020–2025, Cyprus's Digital Skills Strategy 2021–2027, and the Czech Republic's AI National Strategy 2021.

3. **Academic literature**, comprising peer-reviewed studies published between 2020 and 2025 on AI in education, ethics, and digital skills. These sources include systematic reviews and empirical research addressing pedagogical integration, algorithmic bias, and accessibility (e.g., Fu & Weng, 2024; Slimi & Villarejo-Carballido, 2024; Garzón et al., 2025).

4. **Grey literature**, such as reports from Cedefop (2025), OECD (2025), and UNESCO (2024–2025), as well as outputs from Erasmus+ projects (e.g., CHARLIE, EduAId, AI.D), which provide insights into emerging practices and innovative methodologies.

To ensure relevance and comparability, the following inclusion criteria were applied:

- **Publication date**: Initially, the inclusion criteria focused on sources published between 2020 and 2025 to ensure alignment with current policy and technological developments. However, during the review phase, the scope was enriched by incorporating seminal strategic documents from 2017 and 2018 (e.g., DigCompEdu, EQF framework) to provide historical continuity and strengthen the conceptual foundation of the analysis.

- **Topical relevance**: Direct connection to AI integration in education, digital competence frameworks, or microcredential practices.
- **Language**: Availability in English or national languages (Spanish, Portuguese, Greek, Czech), enabling comprehensive coverage of EU and national contexts.

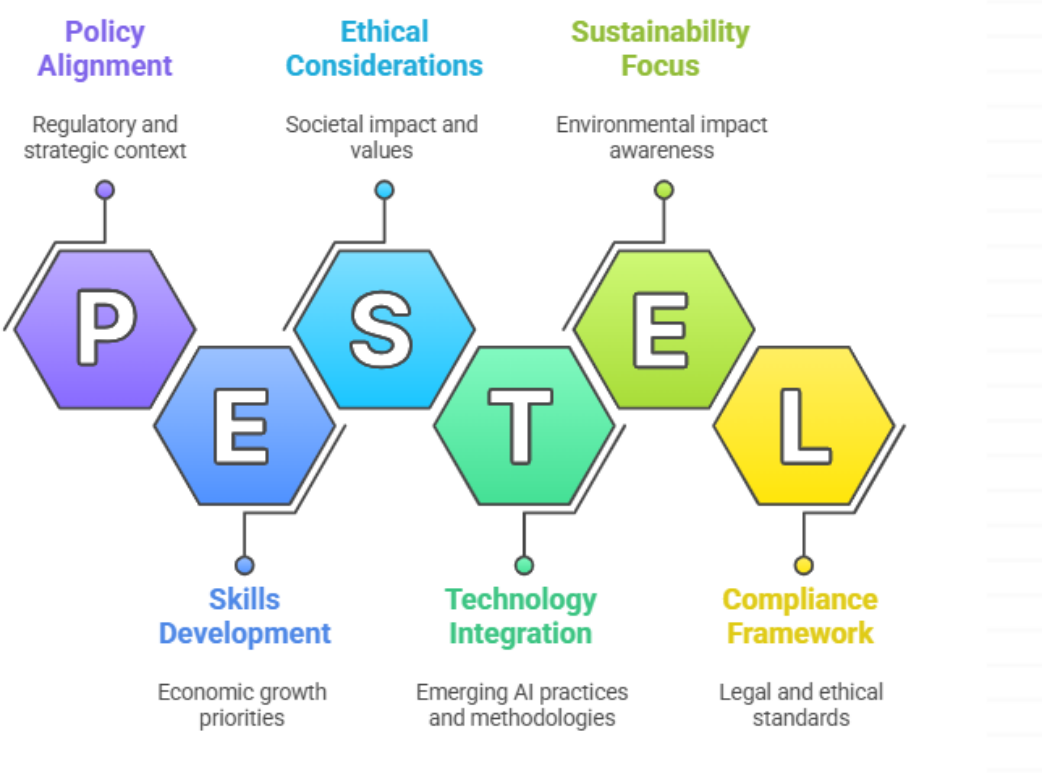
The **search strategy** combined academic databases (e.g., Scopus, ERIC) with official EU repositories (EUR-Lex, Publications Office) and project platforms (EPALE, Erasmus+). Boolean operators and filters were used to refine searches with terms such as “AI literacy in education”, “EQF microcredentials”, and “national AI strategy”. Screening was conducted in two stages: (1) title and abstract review to exclude irrelevant sources, and (2) full-text analysis for thematic relevance.

A **thematic coding schema** was developed to classify content into five categories: policy and regulation, competence frameworks, microcredential practices, ethics and inclusion, and accessibility standards. This enabled cross-comparison and synthesis of findings, supporting the identification of gaps and opportunities for competence development.

In addition, a PESTEL framework was applied to interpret macro-environmental factors influencing AI integration in education. This approach captured political and regulatory drivers (e.g., EU Digital Education Action Plan, AI Act), economic constraints related to infrastructure and funding, social dimensions such as inclusion and teacher readiness, technological enablers and barriers, environmental considerations linked to sustainable digitalization, and legal requirements for data protection and algorithmic transparency. The PESTEL analysis draws on Karadzhov & Patarchanova (2025) for its scholarly evolution and integration with multi-criteria techniques, Belsare (2025) for methodological structure, PESTLEanalysis.com (2023) for applications in AI education, and Dương (2025–2026) for educational contexts.

Incorporating PESTEL ensures that the competence matrices designed under WP2 are informed not only by educational frameworks but also by systemic factors shaping their feasibility and impact.

Figure 1. Adapted PESTEL Framework for AI Integration in Education



Source: Adapted from Johnson et al. (2017) and contextualized for AI in education based on Karadzhov & Patarchanova (2025) and PESTEL analysis.com (2023).

The adapted PESTEL framework informs our analysis by linking each dimension to AI integration challenges and opportunities in education:

- Political & Legal: Regulatory frameworks such as the EU Digital Education Action Plan and AI Act guide compliance and governance.
- Economic: Funding and infrastructure constraints shape implementation feasibility.
- Social: Inclusion, equity, and teacher readiness connect to ethical and pedagogical considerations.
- Technological: Enablers and barriers influence scalability and innovation pathways.
- Environmental: Sustainable digitalization aligns with green education policies.

This systemic lens strengthens WP2 competence matrices, making them resilient to external drivers and aligned with European standards.

The research acknowledges certain limitations, including the rapid evolution of AI-related policies, uneven availability of national strategies in English, and limited empirical evidence on AI-specific microcredentials in some countries. Despite these

constraints, the methodology provides a robust foundation for WP2 by integrating diverse sources and aligning findings with European standards.

3. EU & NATIONAL POLICY LANDSCAPE

The integration of Artificial Intelligence (AI) in education is framed by several key European initiatives that aim to ensure ethical, inclusive, and interoperable practices across Member States. The Digital Education Action Plan 2021–2027 (European Commission, 2020) sets the strategic vision for transforming education systems to become more resilient and digitally competent. It emphasizes the development of high-quality digital learning environments, teacher training, and the integration of emerging technologies such as AI, while safeguarding equity and accessibility.

Complementing this, the Artificial Intelligence Act (European Parliament & Council, 2024) introduces a regulatory framework for trustworthy AI, establishing principles of transparency, accountability, and fairness. Its implications for education are significant, as institutions must ensure compliance when deploying AI-driven tools for assessment, personalization, or administrative processes. The European Qualifications Framework (EQF) (European Commission, 2017) provides a common reference for describing learning outcomes in terms of knowledge, skills, and responsibility/autonomy. Aligning AI-related competencies with EQF levels ensures comparability and recognition across Europe. Similarly, the DigCompEdu framework (European Commission, 2018) offers a structured approach to digital competence for educators, which serves as a foundation for integrating AI literacy dimensions. Finally, the Europass system (European Commission, 2023) and the Council Recommendation on microcredentials (Council of the European Union, 2022) further reinforce the need for modular, verifiable, and transferable credentials. These instruments enable educators to certify AI-related skills through interoperable microcredentials, supporting lifelong learning and professional mobility.

While European frameworks provide overarching guidance, national strategies operationalize these principles within specific contexts. Five countries were selected for this analysis—Spain, Portugal, Greece, Cyprus, and the Czech Republic—representing diverse educational systems and digital readiness levels.

Spain's *Estrategia Nacional de Inteligencia Artificial* (ENIA, 2020) positions AI as a strategic driver for innovation and competitiveness, with education identified as a priority sector. The strategy emphasizes ethical AI adoption, transparency, and human-centered design, aligning with the EU AI Act principles (European Parliament & Council, 2024). Complementing this, RD 272/2022 establishes the Spanish Qualifications Framework for Lifelong Learning, reinforcing competence-based training and interoperability with EQF descriptors. Initiatives such as teacher upskilling programs and vocational education reforms aim to integrate AI literacy into curricula, though implementation remains uneven across regions. A notable gap is the absence of formal

microcredential pathways for AI competencies, limiting portability and recognition (Government of Spain, 2022).

Portugal demonstrates strong alignment with EU priorities through INCoDe.2030 and AI Portugal 2030. These strategies prioritize digital inclusion and AI literacy, embedding objectives in teacher training and higher education curricula. INCoDe.2030 adopts a holistic approach, addressing infrastructure, skills development, and research, while AI Portugal 2030 introduces ethical guidelines and sectoral applications. Despite these advances, microcredential frameworks are still emerging, and recognition mechanisms for short courses remain fragmented. This creates challenges for educators seeking formal certification of AI-related skills (OECD.AI, 2025).

The National Digital Strategy 2020–2025 positions AI integration within a broader digital transformation agenda. Key priorities include accessibility, universal design, and the modernization of educational platforms. Greece has launched initiatives to promote AI literacy among teachers and students, supported by EU-funded projects. However, the strategy lacks detailed operational plans for competence-based certification and microcredentialing, which limits alignment with EQF and Europass standards. Ethical considerations are addressed at a policy level but require stronger implementation in teacher training programs (Ministry of Digital Governance, 2021).

In Cyprus, the Digital Skills Strategy 2021–2027 identifies AI as a key enabler for educational innovation, focusing on capacity-building for educators and alignment with EU frameworks. Cyprus emphasizes inclusion and accessibility, integrating AI into digital skills programs for schools and vocational training. While the strategy acknowledges lifelong learning, formal mechanisms for microcredentials and recognition of prior learning (RPL) are underdeveloped. This gap may hinder the scalability of AI literacy initiatives and their interoperability across the European Education Area (Deputy Ministry of Research, Innovation and Digital Policy, 2025).

In the Czech Republic, the National AI Strategy 2021 underscores ethical AI use and digital competence development, with specific measures for higher education and vocational training. The Czech approach includes partnerships with universities to advance AI research and teacher training. However, similar to other Member States, the absence of standardized microcredential frameworks and explicit EQF alignment creates barriers to cross-border recognition. Ethical principles are embedded in policy but require operationalization through competence-based curricula and assessment tools (Ministry of Industry and Trade, 2021).

The review of European and national strategies reveals that the integration of AI in education is not only a pedagogical challenge but also a systemic transformation influenced by multiple macro-environmental factors.

As illustrated in table 1, applying a PESTEL lens provides a holistic understanding of these dynamics:

Table 1. PESTEL Analysis EU & national policy landscape

PESTEL ANALYSIS BY AREA	DESCRIPTION
Political	Strong EU governance through the Digital Education Action Plan and the AI Act establishes a regulatory environment that prioritizes ethical and inclusive AI adoption. National strategies echo these priorities but vary in operationalization, creating uneven implementation across Member States.
Economic	Investment in digital infrastructure and teacher upskilling is critical for scaling AI integration. Countries such as Portugal and Spain allocate resources through national programs (INCoDe.2030, ENIA), yet disparities in funding and regional capacity persist, potentially widening the digital divide.
Social	Policies emphasize inclusion and universal design, but practical measures for accessibility and equity remain limited. Teacher readiness and public trust in AI are emerging social factors that influence adoption, requiring targeted professional development and awareness campaigns
Technological	The availability of interoperable AI platforms and alignment with frameworks like DigCompEdu and EQF are essential for standardization. However, gaps in microcredential systems and recognition of prior learning hinder technological scalability and competence portability.
Environmental	While rarely addressed explicitly, the sustainability of digital transformation—including the energy footprint of AI systems—should be integrated into future strategies to align with EU Green Deal objectives.
Legal	Compliance with GDPR, the AI Act, and ethical guidelines for trustworthy AI introduces complex obligations for educational institutions. These legal requirements necessitate competencies in data governance and algorithmic transparency within teacher training programs.

Source: own elaboration.

This PESTEL-informed analysis highlights that successful AI integration in education depends on coordinated action across these dimensions. While European frameworks provide a strong foundation, national strategies must strengthen interoperability, embed ethical and accessibility principles in practice, and develop robust microcredential systems. Addressing these systemic factors will ensure that competence matrices designed under WP2 are not only pedagogically sound but also as resilient as possible to political, economic, and technological shifts.

Despite shared objectives, gaps remain in interoperability and recognition. National frameworks often lack explicit references to microcredentials or standardized competence descriptors for AI literacy. This creates challenges for cross-border recognition and mobility. Aligning national strategies with EU frameworks such as EQF, DigCompEdu, and Europass is essential to ensure consistency, portability, and inclusivity. This alignment will facilitate the development of competence matrices that support lifelong learning and professional mobility across Europe.

4. FRAMEWORKS & STANDARDS REVIEW

The integration of Artificial Intelligence (AI) in education requires alignment with established frameworks and standards to ensure quality, interoperability, and ethical compliance. This section reviews key European and international references that inform the design of competence matrices for EQF levels 4 and 6.

The European Digital Competence Framework for Educators (DigCompEdu) (European Commission, 2018) is a cornerstone for digital skills development in education. It organizes competencies into six areas:

1. Professional engagement
2. Digital resources
3. Teaching and learning
4. Assessment
5. Empowering learners
6. Facilitating learners' digital competence

While DigCompEdu does not explicitly address AI, its structure provides a foundation for integrating AI literacy dimensions such as algorithmic transparency, ethical use, and accessibility. These additions respond to emerging needs identified by UNESCO (2024) and OECD (2025).

Institutional policies increasingly reference compliance with the Artificial Intelligence Act (European Parliament & Council, 2024) and the Ethics Guidelines for Trustworthy AI (European Commission, 2020). These documents establish principles of fairness, accountability, and explainability, which must be embedded in educational practices.

Resources such as the European Code of Conduct for Research Integrity and UNESCO's AI Competency Framework for Teachers (2024) emphasize ethical considerations, including bias prevention and transparency. As AI introduces new challenges for academic integrity, particularly in automated assessment and content generation, these principles inform the design of competencies related to responsible AI use.

Accessibility guidelines such as WCAG 2.1 (W3C, 2018), ensure digital environments are usable by individuals with disabilities. Universal Design for Learning (UDL) principles complement these standards, promoting adaptability for diverse learners, including neurodivergent students and those in rural contexts.Inclusive AI integration requires adherence to these accessibility principles to ensure equitable learning experiences for all.

International models, such as the OECD & European Commission AI Literacy Framework (2025) and UNESCO's AI Competency Framework (2024), provide structured approaches to AI education. These frameworks highlight dimensions such as conceptual understanding, ethical reasoning, and pedagogical application, which align with EQF descriptors of knowledge, skills, and responsibility/autonomy.

To ensure interoperability, the reviewed frameworks were mapped against EQF descriptors:

- Knowledge: Understanding AI concepts, ethical principles, and accessibility standards.
- Skills: Applying AI tools in teaching, designing inclusive digital resources, and implementing assessment strategies.
- Responsibility & Autonomy: Making informed decisions on AI integration, ensuring compliance with legal and ethical standards, and promoting equity in digital learning environments.

Adapted to EQF4 and 6 the following table provides examples of descriptors for both levels:

Table 2. Mapping Frameworks to EQF Descriptors with Examples from EQF4 and 6

	EQF4	EQF6
Knowledge	*Understands basic AI concepts and their application in teaching practice.* Example: A vocational trainer can explain what a Large Language Model (LLM) is and identify common AI tools used for adaptive learning platforms.	*Demonstrates advanced conceptual understanding of AI models, ethical principles, and institutional policies.* Example: A university lecturer critically analyzes algorithmic bias and interprets AI-driven analytics for research and curriculum design.
Skills	*Applies AI tools to enhance learning activities and assessment in practical contexts.* Example: An adult educator uses an AI-based quiz generator to personalize learning for diverse learners.	*Designs and evaluates AI-integrated pedagogical strategies, ensuring validity and reliability.* Example: A professor develops a blended learning course incorporating AI-driven

	EQF4	EQF6
		formative assessment and learning analytics dashboards.
Responsibility & Autonomy	*operates AI tools responsibly in routine contexts, ensuring fairness and data protection.* Example: A teacher follows institutional protocols for using AI-based grading systems and informs learners about privacy safeguards.	*Leads decision-making on AI adoption, ensuring compliance with legal and ethical standards.* Example: A faculty member develops policy guidelines for AI tools to ensure academic integrity and accessibility compliance.

Source: own elaboration.

This mapping supports the development of competence matrices that are coherent with European standards and adaptable to diverse educational contexts.

5. BENCHMARK OF EXISTING AI-IN-EDUCATION COMPETENCIES & COURSES

The benchmarking of existing AI-in-education initiatives provides critical insights into current practices, transferable elements, and gaps that inform the design of competence matrices for EQF levels 4 (Adult Education/Youth) and 6 (Higher Education).

In adult education and youth programs (EQF4), competencies prioritize practical application and inclusivity. Erasmus+ initiatives have introduced short courses and modular training that integrate AI into vocational education and non-formal learning. Core areas include digital teaching: Using adaptive platforms and AI-driven tools to enhance engagement and learning outcomes (European Commission, 2018), ethical principles ensuring fairness, transparency, and data protection in digital environments (Fu & Weng, 2024), gamification with playful elements to motivate learners, supported by AI personalization (Slimi & Villarejo-Carballido, 2024) and accessibility, that is designing resources aligned with WCAG 2.1 and Universal Design for Learning principles to support diverse learners (W3C, 2018; UNESCO, 2024).

In higher education (EQF6), the CHARLIE project (Erasmus+, 2022–2025) exemplifies an innovative approach by addressing algorithmic bias and ethical AI use through gamified learning modules and evaluative games. These resources aim to foster critical thinking and ethical reasoning among educators and students (CHARLIE Project, 2025). Similarly, EduAId (2024–2027) focuses on microcredentials for teachers and administrators, emphasizing inclusive AI integration and accessibility in educational contexts (EduAId Consortium, 2025). Competencies at EQF6 typically encompass Advanced AI literacy, understanding algorithms, data ethics, and implications for research and teaching (OECD & European Commission, 2025); Pedagogical integration,

designing learning experiences that leverage AI for personalization and formative assessment (Slimi & Villarejo-Carballido, 2024); Institutional compliance, that is, applying governance frameworks aligned with the AI Act and GDPR (European Parliament & Council, 2024) and innovation and research using AI tools for scholarly inquiry and methodological enhancement (Garzón et al., 2025). These competencies reflect a shift toward critical and ethical engagement with AI, moving beyond technical proficiency to include responsibility and autonomy in decision-making.

These competencies respond to the need for inclusive digital transformation, particularly for vulnerable groups and rural educators.

Moreover, in this frame, microcredentials have emerged as a flexible mechanism for certifying AI-related skills. Some of its key features include modularity, that is short, stackable units aligned with EQF descriptors (Council of the European Union, 2022), interoperability, integration with Europass for verifiable and transferable credentials (European Commission, 2023) and evidence-based assessment including use of artefacts, rubrics, and performance indicators to validate learning outcomes (EduAId Consortium, 2025). EduAId demonstrates exemplary practice by embedding microcredentials within a digital platform, ensuring alignment with European standards and promoting professional mobility.

The transferable elements across initiatives may include ethical AI principles (bias prevention, transparency), pedagogical strategies for AI integration and accessibility standards (WCAG, UDL). However, notable gaps persist, such as limited attention to bias and fairness in vocational contexts, insufficient focus on assessment integrity when using AI-driven tools, lack of Recognition of Prior Learning (RPL) mechanisms for informal AI competencies and underrepresentation of accessibility and inclusion in higher education courses. Addressing these gaps is essential for developing competence matrices that are comprehensive, inclusive, and adaptable to diverse educational settings.

6. EVIDENCE-TO-COMPETENCY SYNTHESIS

This chapter represents the critical step of translating research findings into actionable learning outcomes aligned with the European Qualifications Framework (EQF).

This section strengthens the chain of custody from European legislation and authoritative frameworks to the proposed learning outcomes at EQF 4 and EQF 6. It documents how each key learning area is anchored in:

1. binding law (e.g., EU AI Act, GDPR),
2. pan European policy instruments (EQF, Micro credentials, Europass, DEAP), and
3. pedagogical/technical frameworks (DigCompEdu, OECD EC AI Literacy, UNESCO AI Competencies, WCAG/UDL). The approach ensures that the matrices in Tables 5 and 6 translate policy into measurable competencies and assessment criteria, consistent with EQF descriptors of knowledge, skills, responsibility/autonomy. [op.europa.eu], [eur-lex.europa.eu]

1 Legislative anchor relevant to AI in education

- **EU Artificial Intelligence Act (Regulation (EU) 2024/1689):** establishes a risk based regime (prohibited, high risk, limited, minimal), transparency duties (e.g., labeling), governance for general purpose AI models, and introduces AI literacy obligations (Art. 4) for providers/deployers—directly motivating institutional competence building for educators and staff (strategic at EQF 6; operational at EQF 4). (
- **GDPR (Regulation (EU) 2016/679):** frames lawful processing in learning analytics and AI assisted assessment (Arts. 5–6), special categories (Art. 9), DPIA needs (Art. 35), data subject rights, and automated decision-making safeguards (Art. 22). These are critical for AI mediated assessment, feedback, and proctoring use cases.
- **EQF (Council Recommendation, 2017):** prescribes the learning outcome language and the three descriptors (knowledge, skills, responsibility/autonomy) used to structure Tables 5–6 and to calibrate levels 4 and 6. (Council of the EU, 2017).
- **Micro credentials (Council Recommendation, 2022) & Europass European Digital Credentials (EDC):** enable stackable, verifiable recognition for the modules derived from the matrices, with common descriptors and machine verifiable issuing via Europass wallets—supporting portability and QA.
- **Digital Education Action Plan (2021–2027):** mandates actions on ethical AI guidelines for educators, digital pedagogy, and measurement—providing a policy scaffold for the competency areas (teaching, assessment, inclusion, literacy). (European Commission, 2020/2023.

2 Frameworks and standards operationalizing the competences

- **DigCompEdu:** six domains and 22+ competences form the baseline to which AI specific competencies are mapped (professional engagement, digital resources, teaching/learning, assessment, empowering learners, and learners' digital competence). (Redecker & Punie, 2017/2018).
- **UNESCO AI Competency Framework for Teachers (2024):** specifies 15 AI related competencies in five dimensions (human centred mindset, ethics, AI foundations & applications, AI pedagogy, AI for professional learning) with Acquire–Deepen–Create progression; it complements DigCompEdu with AI specific depth. (Miao & Cukurova, 2024).
- **OECD–European Commission AI Literacy Framework** (review draft, 2025): outlines engage/create/manage/design competences for AI literacy, aligns with DEAP and references AI Act Art. 4 AI literacy, relevant for educators' and learners' capabilities and for school wide adoption strategies (OECD & EC, 2025).
- **Ethics Guidelines for Trustworthy AI (EU HLEG, 2019):** seven requirements (human agency/oversight, robustness/safety, privacy/data governance, transparency, diversity/fairness, societal/environmental wellbeing, accountability) provide practical assessment lists to embed in course QA and institutional policy.
- **Accessibility: WCAG 2.1/2.2 and Universal Design for Learning principles underpin inclusive design** (captions, alternatives, keyboard access, cognitive load reduction, focus visibility, target size, accessible authentication). WCAG 2.2 adds nine new success criteria (e.g., Focus Not Obscured, Dragging Movements, Target Size, Consistent Help, Accessible Authentication) (W3C, 2025; W3C, 2023).

Note: The EQF aligned learning outcomes in Tables 3 and 4 already integrate these anchors; the mapping below makes this linkage explicit and auditable for QA, validation, and micro credential design. The domains proposed for EQF4 and EQF6 are explicitly selected based on recurring themes in European frameworks (DigCompEdu, AI Competency Framework) and peer-reviewed literature on digital pedagogy and AI integration.

The distinction in emphasis between the two levels is a central finding of the desk research and reflects their distinct roles:

- **EQF4 (Applied Engagement):** EQF4 teachers focus on applied, learner-centered practices, needing the skill to operate AI tools responsibly in routine contexts, ensuring fairness and data protection.
- **EQF6 (Strategic Governance):** EQF6 teachers lead strategic and research-driven integration, requiring them to lead decision-making on AI adoption, ensuring compliance with legal and ethical standards (Responsibility & Autonomy).

EQF Level 4 (Adult and Vocational Educators): The EQF4 domains prioritize practical, applied, and learner-centered practices. The focus areas included in the application and supported by sources identified in the benchmarking are described in table 3 below.

Table 3. EQF4 focus areas, supporting evidence & source alignment.

EQF4 Focus area	Framework/Standard Alignment	Description and Implications for LOs & Assessment
Digital Teaching	DigCompEdu Areas 2–4; UNESCO "AI pedagogy"; OECD-EC AILiteracy "engage"	Focuses on practical application, such as operating AI tools responsibly in routine contexts. This includes using adaptive platforms and AI-driven tools to enhance engagement. **Implications for LOs & Assessment:** Demonstrate safe configuration and disclosure when using AI supports; evidence via lesson artefacts and explainable prompts.
Assessment & Ethics	DigCompEdu Area 4; HLEG 7 requirements	Requires applying rubrics and supervising AI feedback to ensure fairness. Outcomes focus on implementing consent templates and avoiding sensitive data, reflecting a practical application of core ethical principles (privacy, fairness). **Implications for LOs & Assessment:** Apply transparent rubrics; supervise AI feedback; no solely automated decisions
Gamification	UNESCO "AI pedagogy"; OECD-EC AILiteracy "create"	Identified as a core practical area for non-formal learning, integrating playful elements supported by AI personalization to motivate learners. **Implications for LOs & Assessment:** Design lightweight, inclusive gamified tasks; disclose AI-generated elements; mitigate bias in reward mechanics.
Accessibility	WCAG 2.1/2.2; UDL	Emphasizes adherence to standards like WCAG 2.1 and UDL principles to support diverse learners, including those in rural contexts or with neurodivergent needs.

EQF4 Focus area	Framework/Standard Alignment	Description and Implications for LOs & Assessment
		Implications for LOs & Assessment: provide alt formats/captions, keyboard access, target size ≥24px, accessible authentication; low-bandwidth options.
Collaboration	DigCompEdu Areas 1 & 5; OECD-EC AILit "manage"	Focuses on using AI tools to facilitate peer feedback and group activities while ensuring equitable participation. **Implications for LOs & Assessment:** Facilitate AI-supported peer feedback with role equity and privacy-aware settings; log roles/contributions.

EQF Level 6 (Higher Education Professors): The EQF6 domains emphasize a strategic and research-driven integration role, focusing on strategic and ethical governance. The competency areas included in the application and supported by the sources identified are:

Table 4. EQF6 focus areas, supporting evidence & source alignment.

EQF6 Focus area	Framework/Standard Alignment	Description and Implications for LOs & Assessment
AI Literacy	OECD-EC AILit (engage/create/manage/design); UNESCO AI competences	Focuses on advanced conceptual understanding of AI models, data ethics, and their implications for research and teaching. This aligns with international models such as the OECD & European Commission AI Literacy Framework and UNESCO's AI Competency Framework. **Implications for LOs & Assessment:**
Ethics & Policy	HLEG Trustworthy AI	Emphasizes institutional compliance and leading decision-making. The outcomes include explaining the General Data Protection Regulation (GDPR) and AI Act risk categories. This aligns directly with regulatory imperatives. **Implications for LOs & Assessment:**
Pedagogy & Assessment	DigCompEdu 2–4; UNESCO "AI pedagogy"; WCAG/UDL	Requires the design and evaluation of AI-integrated pedagogical strategies, ensuring validity and reliability. Outcomes include designing inclusive, AI-enhanced learning experiences aligned with UDL principles and developing transparent rubrics for fair evaluation. This is supported by academic literature on pedagogical integration (e.g., Slimi & Villarejo-Carballido, 2024). **Implications for LOs & Assessment:**

EQF6 Focus area	Framework/Standard Alignment	Description and Implications for LOs & Assessment
Engagement	OECD-EC AILit (agency & creation); HLEG (agency/oversight)	Strategies for AI-supported collaboration and motivation. **Implications for LOs & Assessment:**

These defined outcomes serve as the foundation for curriculum design, microcredential development, and quality assurance for the entire project.

The synthesis process culminates in two (2) structured proposals of overall learning outcomes for EQF Levels 6 and 4. These tables operationalize the evidence gathered into clear descriptors of knowledge, skills, and attitudes, ensuring alignment with EQF language and incorporating principles of ethics, accessibility, and Universal Design for Learning (UDL).

Each set of outcomes is designed to guide curriculum development and microcredential frameworks, providing educators with actionable pathways to integrate AI responsibly and inclusively into their practice. The following tables present the draft learning outcomes for both levels.

The following table presents the proposed learning outcomes for EQF Level 4, aimed at educators in adult education, vocational training, and youth programs who require practical competencies to integrate AI tools into teaching and learning. These outcomes are structured according to the three EQF dimensions—Knowledge, Skills, and Attitudes—and have been also developed in line with the EASO Guide to Writing Learning Outcomes and the European Qualifications Framework Handbook to ensure clarity, measurability, and alignment with European standards (European Commission, 2018; European Asylum Support Office, 2018). The descriptors emphasize accessible and inclusive practices, ethical use of AI, and learner engagement through strategies such as gamification and Universal Design for Learning (UDL). This matrix provides a foundation for modular training and microcredential pathways, supporting lifelong learning and professional mobility within the European Education Area.

Table 5. Draft proposal of EQF 4 OVERALL LEARNING OUTCOMES

EQF 4 OVERALL LEARNING OUTCOMES		
Upon completion of the training experience, the learner will be able to		
KNOWLEDGE	**SKILLS**	**ATTITUDES**
Identify basic AI applications in education and describe their benefits and risks.	Use AI tools to create lesson materials and formative checks while following privacy basics.	Show openness to innovation and maintain responsible classroom practices.
Recognize AI-assisted assessment methods and integrity principles.	Apply rubrics and supervise AI feedback to ensure fairness and transparency.	Value honesty and fairness in evaluation processes
Understand core ethical principles (privacy, fairness, consent) and institutional guidelines for AI use.	Implement consent templates and avoid sensitive data in AI-supported activities.	Demonstrate respect for learner rights and data protection.
Identify gamification strategies and AI personalization features for motivation.	Design simple, inclusive gamified activities aligned with learning outcomes.	Promote healthy engagement and avoid competitive bias.
Understand WCAG basics and Universal Design	Provide alternative formats (text/audio), captions, and low-bandwidth options for rural learners.	Commit to equity and proactive accommodation for diverse learners.
Recognize AI-supported collaboration tools and digital etiquette.	Facilitate peer feedback and group activities using AI tools while ensuring equitable participation.	Foster inclusivity, empathy, and shared responsibility in digital learning environments

The following table presents the proposed learning outcomes for EQF Level 6, designed for higher education professors and academic staff who will lead the integration of Artificial Intelligence in teaching, research, and institutional governance. These outcomes are structured according to the three EQF dimensions, Knowledge, Skills, and Responsibility & Autonomy, and have been crafted using the EASO Guide to Writing Learning Outcomes and the European Qualifications Framework Handbook. The EASO Guide (European Asylum Support Office, 2018) ensures clarity, measurability, and alignment with Bloom's Taxonomy, while the EQF Handbook (European Commission, 2018) confirms consistency with European-level descriptors and classification criteria. Each descriptor also integrates advanced competencies from the AI Act, DigCompEdu, and Universal Design for Learning (UDL), emphasizing critical thinking, autonomy, and responsibility. This matrix provides the foundation for course development, which in turn equips educators to design AI-enhanced learning experiences, safeguard data privacy, and advocate for transparency and fairness. It also forms a foundation for curriculum development and microcredential frameworks aligned with Europass, supporting professional mobility and lifelong learning.

Table 6. Draft proposal of EQF 6 OVERALL LEARNING OUTCOMES

EQF 6 OVERALL LEARNING OUTCOMES		
Upon completion of the training experience, the learner will be able to		
KNOWLEDGE	**SKILLS**	**ATTITUDES**
Explain advanced AI paradigms (including machine learning models, training data, evaluation metrics, and bias/variance, generative AI, etc), explain model lifecycle, and interpret algorithmic bias principles.	Critically evaluate AI tools for teaching and research, configure settings responsibly, and interpret analytics for pedagogical decisions.	Advocate transparency, equity, and fairness, maintaining human oversight in AI-supported learning.
Explain GDPR, AI Act risk categories, and ethical frameworks.	Ensure compliance with data protection and ethical standards when integrating AI tools into teaching and research.	Demonstrate responsibility for learner rights, privacy, and equitable outcomes in all AI-mediated processes.
Understand AI-supported instructional design, Universal Design for Learning (UDL) principles, and implications for learner agency.	Design inclusive, AI-enhanced learning experiences aligned with learning outcomes and accessibility standards (WCAG 2.1).	Promote student-centered approaches and resist over-automation that undermines autonomy.
Recognize AI-enabled assessment methods, validity/reliability issues, and integrity safeguards.	Develop transparent rubrics, calibrate AI feedback systems, and triangulate evidence for fair evaluation.	Value fairness, academic integrity, and formative growth in AI-mediated assessment.
Identify strategies for AI-supported collaboration, motivation, and adaptive feedback.	Facilitate learner engagement through AI-driven personalization and collaborative platforms while monitoring equity.	Foster belonging, inclusivity, and psychological safety in digital learning environments.
Interpret institutional and EU AI policies, EQF descriptors, and microcredential standards for competence mapping.	Draft institutional guidelines, align training with quality assurance frameworks, and plan credential interoperability (Europass).	Commit to continuous improvement, proactive compliance, and advocacy for ethical AI governance.

This initial draft organizes the proposed learning outcomes into thematic competence units that reflect the priorities identified in the desk research. For EQF Level 4, the emphasis is placed on digital teaching, assessment, ethics, gamification, accessibility, and collaboration. For EQF Level 6, the focus areas include AI literacy, ethics, pedagogy, assessment, learner engagement, and policy. These units provide a structured foundation for developing detailed competency matrices aligned with European standards and inclusive design principles.

These thematic clusters set the stage for collaborative processes, informing the co-design and validation strategies discussed in the following section.

7. IMPLICATIONS FOR CO-DESIGN & VALIDATION

The successful development of EQF-aligned AI competency matrices depends on a **rigorous and participatory process that ensures both relevance and inclusivity**. Co-design and validation are not merely procedural steps; they constitute the methodological backbone that transforms theoretical constructs into actionable frameworks for educators. This section discusses the implications of these processes, highlighting their role in guaranteeing quality, stakeholder ownership, and compliance with ethical and legal standards.

Co-design is grounded in principles of Experience-Based Co-Design (EBCD), which prioritizes stakeholder engagement in the creation of educational innovations (Bate & Robert, 2007). For EQF Level 6, structured focus groups with higher education professors, AI specialists, and policy advisors will refine competencies in domains such as AI literacy, ethics, pedagogy, assessment, learner engagement, and policy. Similarly, for EQF Level 4, co-design workshops will involve adult educators, youth trainers, and inclusion specialists to ensure that competencies (digital teaching, assessment, ethics, gamification, accessibility, and collaboration), reflect practical realities in diverse learning environments.

These sessions employ guided dialogue and scenario-based exercises to elicit critical insights. Personas representing varied educator profiles, such as the digitally experienced professor, the rural adult educator, and the inclusion advocate, are integrated to capture heterogeneous needs and mitigate the risk of designing frameworks biased toward technologically advanced contexts.

Internal validations, conducted through peer review ensures methodological coherence and alignment with European frameworks such as the European Qualifications Framework (EQF) and DigCompEdu (European Commission, 2018). External validation, conducted through surveys and expert consultations, extends this scrutiny to a broader audience, including educators, policymakers, and AI ethics specialists. Validation criteria encompass relevance, clarity, inclusivity, and practical applicability, with particular attention to ethical compliance and accessibility standards such as WCAG and Universal Design for Learning (UDL) (CAST, 2018). Validation serves as the cornerstone of credibility and transferability.

Both co-design and validation processes must operate within a framework of ethical responsibility and data protection. Risks such as algorithmic bias, misuse of AI tools, and breaches of privacy are addressed through explicit integration of ethics competencies and adherence to GDPR requirements (European Union, 2016). Consent protocols, anonymization of data, and transparent communication of privacy policies are mandatory safeguards. Ethical deliberation within workshop agendas reinforces the normative dimension of AI integration, ensuring that technological innovation does not compromise fundamental rights (European Commission, 2020).

Potential risks include underrepresentation of marginalized groups, low engagement in validation phases, and resistance to change. Mitigation strategies involve targeted outreach to disadvantaged educators, persona-based design to capture diverse perspectives, and AI-powered analytics to identify gaps in feedback. Inclusivity is treated as a structural principle embedded in every stage of the process, rather than as an ancillary concern.

Finally, the implications of co-design and validation extend beyond WP2 deliverables. They establish a precedent for participatory governance in educational innovation, fostering trust among stakeholders and enhancing the legitimacy of AI-related competencies. By aligning these processes with European standards and ethical frameworks, the project ensures that the resulting matrices are not only pedagogically sound but also socially responsible and future ready.

8. CONCLUSIONS

This desk research confirms that the integration of Artificial Intelligence in education is both a pedagogical and systemic challenge requiring coordinated action across policy, practice, and technology. By synthesizing evidence from European frameworks, national strategies, and academic literature, the study establishes the necessary foundation for defining AI-related competencies aligned with EQF Levels 4 and 6.

The proposed learning outcomes intend to reflect not only technical proficiency but also ethical responsibility, inclusivity, and accessibility, ensuring that educators are prepared to adapt to AI-enhanced learning environments with autonomy and critical judgment.

Furthermore, the research highlights the importance of microcredential pathways and interoperability with Europass to support lifelong learning and professional mobility. These findings will inform the co-design and validation processes outlined in WP2 and serve as the cornerstone for WP3, where competency matrices will be transformed into structured training programs.

Ultimately, this work contributes to the broader goal of fostering a future-ready European Education Area where AI adoption enhances quality, equity, and trust in education.

REFERENCES

Bate, P., & Robert, G. (2007). *Bringing user experience to healthcare improvement: The concepts, methods and practices of experience-based design. Radcliffe Publishing.*

Boletín Oficial del Estado (BOE). (2022, April 12). Real Decreto 272/2022, de 12 de abril, por el que se establece el Marco Español de Cualificaciones para el Aprendizaje Permanente (BOE-A-2022-7490). https://www.boe.es/buscar/doc.php?id=BOE-A-2022-7490

CAST. (2018). *Universal Design for Learning Guidelines version 2.2.* Retrieved from https://udlguidelines.cast.org

CHARLIE Project. (2025). *Challenging Bias in Big Data for AI & ML*. Erasmus+ KA2.

Council of the European Union. (2022). *Council Recommendation on a European approach to microcredentials for lifelong learning and employability* (2022/C 243/02).

Directorate-General for Communications Networks, Content and Technology (European Commission). (2019, April 8). *Ethics guidelines for trustworthy artificial intelligence (High-Level Expert Group on AI). Publications Office of the European Union.* https://doi.org/10.2759/346720

EduAId Consortium. (2025). *AI microcredentials for educators*. Erasmus+ KA2.

European Asylum Support Office. (2018). *EASO guide to writing* learning outcomes. Luxembourg: Publications Office of the European Union. https://doi.org/10.2847/768154

European Commission. (2017). *European Qualifications Framework for lifelong learning. Publications Office of the European Union.*

European Commission. (2018). *DigCompEdu: The Digital Competence Framework for Educators. Publications Office of the European Union.* https://doi.org/10.2760/178382

European Commission. (2020). *Digital Education Action Plan 2021–2027. Publications Office of the European Union.*

European Commission. (2023). *Europass framework and tools for digital credentials. Publications Office of the European Union.*

European Parliament & Council. (2024). *Artificial Intelligence Act. Official Journal of the European Union*. https://eur-lex.europa.eu/eli/reg/2024/1689/oj

European Union. (2016). *General Data Protection Regulation (GDPR). Regulation (EU) 2016/679.* Official Journal of the European Union.

Fu, Y., & Weng, Z. (2024). *Navigating the ethical terrain of AI in education: A systematic review on framing responsible human-centered AI practices. Computers and Education: Artificial Intelligence*, 7, Article 100306.

Garzón, J., Patiño, E., & Marulanda, C. (2025). *Systematic review of Artificial Intelligence in Education: Trends, benefits, and challenges.*

Johnson, G., Scholes, K., & Whittington, R. (2017). *Exploring strategy: Text and cases (11th ed.). Pearson Education.*

Karadzhov, V., & Patarchanova, E. (2025). *How to create the best PESTEL analysis. International Journal of Digital Research, 1(3), 8–20.* http://doi.org/10.63711/ijdr.net20250301

Lambadarios Law Firm. (2025, February). *What we know so far about Greece's AI national strategy. LLF Article*. https://www.lambadarioslaw.gr/wp-content/uploads/2025/02/LLF-Article-Greeces-AI-NationalStrategy-Feb2025.pdf

Learn & Work Ecosystem Library. (2025, July 8). *AI Literacy Framework for Primary & Secondary Education—OECD-EC*. https://learnworkecosystemlibrary.com/initiatives/ai-literacy-framework-for-primary-secondary-education-oecd-ec/

Miao, F., & Cukurova, M. (2024). *AI competency framework for teachers (UNESCO Education 2030). United Nations Educational, Scientific and Cultural Organization.* https://doi.org/10.54675/ZJTE2084

Ministry of Digital Governance. (2021, July 11). *Digital Transformation Paper 2020–2025 (Decision No 20301/18-06-2021). Digital Skills and Jobs Platform.* https://digital-skills-jobs.europa.eu/en/actions/national-initiatives/national-strategies/greece-digital-transformation-paper-2020-2025

Ministry of Industry and Trade of the Czech Republic. (n.d.). *National Artificial Intelligence Strategy of the Czech Republic [Press release].* https://mpo.gov.cz/assets/en/guidepost/for-the-media/press-releases/2019/5/NAIS_eng_web.pdf

OECD. (2022, January 3). *Spain: National AI Strategy (Estrategia Nacional de Inteligencia Artificial, ENIA). OECD.AI.* https://wp.oecd.ai/app/uploads/2022/01/Spain_National_AI_Strategy_2020.pdf

OECD & European Commission. (2025, May). *Empowering learners for the age of AI: An AI literacy framework for primary and secondary education (Draft review). AILit Framework Initiative.* https://ailiteracyframework.org/wp-content/uploads/2025/05/AILitFramework_ReviewDraft.pdf

OECD.AI. (2025, July 10). *National AI Strategy of the Czech Republic 2030. OECD.AI.* https://oecd.ai/en/dashboards/policy-initiatives/national-ai-strategy-of-the-czech-republic-2030-6563

OECD.AI. (2025, July 14). *AI Portugal 2030 – National Strategy for AI.* https://oecd.ai/en/wonk/documents/portugal-ai-portugal-2019-2030

PESTLEanalysis.com. (2023, December 11). *A PESTLE analysis of AI in education.* https://pestleanalysis.com/pestle-analysis-of-ai-education-research-analysis-essay-writing/

Portugal INCoDe.2030. (n.d.). *INCoDe.2030: National Digital Skills Initiative* https://www.incode2030.gov.pt/en/incode-2030-en/

Redecker, C. (Ed.). (2017, November 29). *European framework for the digital competence of educators: DigCompEdu (EUR 28775 EN).* Publications Office of the European Union. https://doi.org/10.2760/178382

Slimi, Z., & Villarejo-Carballido, B. (2024). *Unveiling the potential: Experts' perspectives on artificial intelligence integration in higher education. European Journal of Educational Research*, 13(4), 1477–1492.

UNESCO. (2024). *AI competency framework for teachers.*

W3C. (2018). *Web Content Accessibility Guidelines (WCAG) 2.1.* https://www.w3.org/TR/WCAG21/ Regulation (EU) 2016/679. Official Journal of the European Union.

W3C. (2023). Web Content Accessibility Guidelines (WCAG) 2.2. World Wide Web Consortium. https://www.w3.org/TR/WCAG22/

W3C. (2025). Web Content Accessibility Guidelines (WCAG) 2.2: Updated success criteria. World Wide Web Consortium. https://www.w3.org/TR/WCAG22/