HEALTH-LOG-AI

Advancing AI Competencies in Healthcare Logistics

D2.1 – REPORT ON THE EXISTING AI LITERACY FRAMEWORKS AND COMPETENCY SCALES

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Disclaimer

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Executive Summary

Artificial intelligence is becoming a key component of modern education and an essential competence for active participation in society. However, the concept of AI literacy is not yet defined in a uniform way. Across academic research, policy documents and international frameworks, multiple definitions coexist, each emphasizing different dimensions of what people should know, understand and be able to do in an AI mediated world.

This report is the result of a desk research aimed at selecting relevant sources and studies on AI literacy frameworks and competency scales across various sectors (including healthcare logistics), from the growing scientific and the grey literature.

The analysis of the main definitions of AI literacy highlights that it is a broad, interdisciplinary construct that encompasses conceptual understanding, ethical awareness, critical evaluation, and the ability to interact with, manage or even create AI systems. The review of the main frameworks published in academic research, policy and industry documents revealed a rich yet common development of main domains. We identified and defined the common domains as follows: AI technical foundations, Human-centricity of AI, Critical thinking, Creating AI systems, Understanding AI social impact, Managing AI ethical issues, Specific domain expertise (e.g. in pedagogy). Together with the analysis of the main competency scales in EQF framework, the results of the desk research provide some key guidelines to be considered in the definition of the HEALTH-LOG-AI holistic AI literacy framework (deliverable D2.3).

1. Introduction

1.1 Purpose of the document

The purpose of this report is to review and analyse existing AI literacy frameworks and competency scales across various sectors (including healthcare logistics), considering 1) academic papers, practice and policy reports, and case studies that have explored AI literacy; 2) frameworks that are already in use or have been developed for AI competencies in other fields, helping to create a foundation for WP2; and 3) the EQF (and others) as a model for aligning AI literacy standards.

The report gathers and compares several authoritative definitions and frameworks of AI literacy to clarify how the concept is interpreted and to establish a coherent foundation for the framework that will be developed in the project. Moreover, some key recommendations are gathered from EQF and other frameworks like KSA, to ensure the resulting AI literacy frameworks of HEALTH-LOG-AI project are recognized and standardized at the European level.

1.2 Methodology

The desk research aimed at selecting relevant sources from the scientific and the grey literature. For scientific sources, we performed a systematic review of scientific papers published in the business, social sciences and computer science areas. We used the electronic database Scopus and retrieved the articles including the keywords “AI literacy” in Title, Abstract or Keywords fields, written in English, and published in peer-reviewed journals. These criteria yielded a total of 433 papers. Considered the exponential growth and diversity of publications, we selected only papers that 1) are published in journals, 2) are specifically focusing and proposing a framework of AI literacy – thus excluding the ones analysing AI literacy among other dimensions, 3) consider the lifelong learning, training, adult education and professional environment – thus excluding the ones with implications only in the specific context of schools or teachers’ competencies. A total of 48 papers were thus considered in the scientific literature review. The key policy, industry and strategy reports on AI literacy were recovered from sources such as industry reports by UNESCO, OECD and EC, Digital Education Council, Stanford University, for a total of 52 sources considered in the analysis.

2. Definitions of AI literacy

Across international policy documents and academic literature, AI literacy is defined in multiple, sometimes complementary ways. Some definitions emphasise foundational understanding of AI systems, while others focus on practical use,

critical evaluation, ethical awareness, or responsible behaviour. This section reviews the main definitions that inform the following analysis of AI literacy frameworks.

EU AI Act

The EU AI Act is particularly relevant because it does not frame AI literacy only as an educational or conceptual issue, but also as an organisational requirement. Article 4 requires providers and deployers of AI systems to take measures, to their best extent, to ensure a sufficient level of AI literacy among staff and other persons dealing with the operation and use of AI systems on their behalf. This obligation must consider their technical knowledge, experience, education and training, the context in which AI systems are used, and the persons or groups of persons on whom those systems are used.

> *'AI literacy' means skills, knowledge and understanding that allow providers, deployers and affected persons, taking into account their respective rights and obligations in the context of this Regulation, to make an informed deployment of AI systems, as well as to gain awareness about the opportunities and risks of AI and possible harm it can cause*
>
> (REGULATION (EU) 2024/1689 laying down harmonised rules on artificial intelligence, "AI Act", Article 3(56))

This regulatory framing makes AI literacy relevant beyond technical experts. It explicitly concerns the people who operate, use, or are affected by AI systems. It also connects AI literacy with risk, context, and responsibility, rather than with generic awareness alone. This implies that AI literacy should be role-sensitive: different users may require different levels and types of knowledge, skills, and understanding depending on how they interact with AI systems and on the possible consequences of their use.

UNESCO AI Competency Framework for Students

> *The AI competency framework for students has been developed hand in hand with a AI competency framework for teachers, to map the set of foundational values, ethical principles, knowledge and understanding that can ensure the proper and effective use of AI by students – an ability sometimes referred to as 'AI literacy'*
>
> (UNESCO, 2024)

UNESCO frames AI literacy through a broader competency perspective. The emphasis is not only on understanding AI systems, but also on developing the values, ethical principles, knowledge, and understanding needed to use AI properly

and effectively. This definition places AI literacy close to citizenship, human agency, and responsible participation in AI-mediated societies.

AILit Framework

> *AI literacy represents the technical knowledge, durable skills, and future-ready attitudes required to thrive in a world influenced by AI. It enables learners to engage, create with, manage, and design AI, while critically evaluating its benefits, risks, and ethical implications*
>
> (AILit Framework, 2025)

The AILit definition explicitly combines knowledge, skills, and attitudes. It is therefore close to a competency-based view of AI literacy, where learners are not only expected to understand AI, but also to interact with it, use it creatively, manage its role in human activity, and critically assess its implications. The framework also highlights that AI literacy intersects with other literacies, as shown in **Figure 1**.

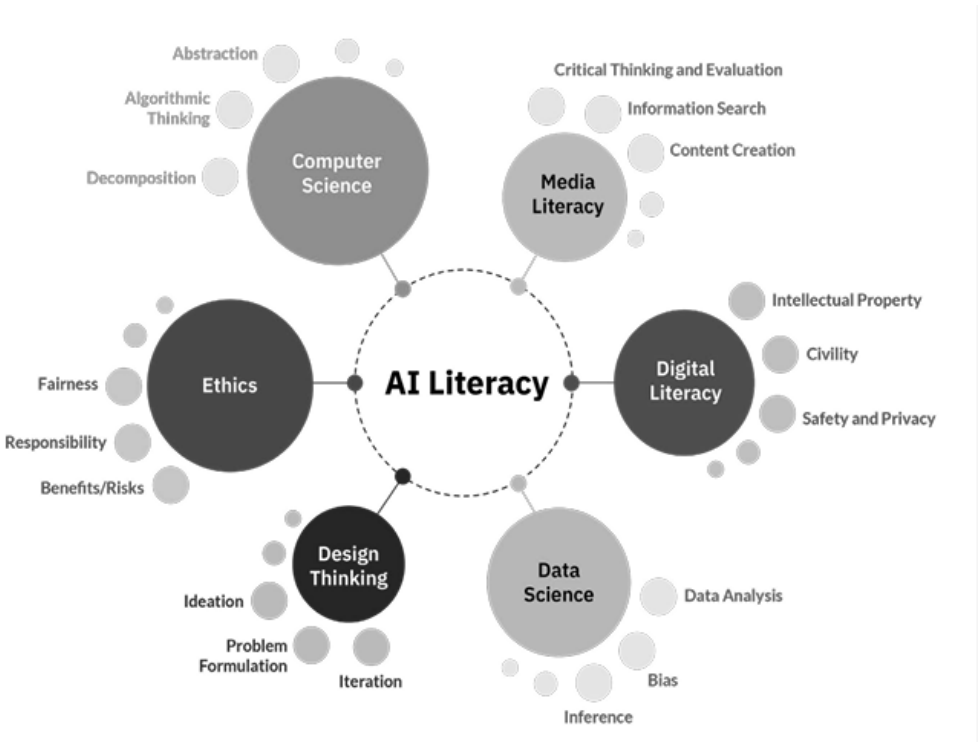

Figure 1. AI and other literacies.

Digital Education Council

> *AI literacy is defined as the essential knowledge and skills needed to understand, interact with, and critically assess AI technologies. AI literacy encompasses the ability to use AI tools effectively and ethically, evaluate their outputs, ensure that human judgment and agency remain central, and adapt to the evolving AI landscape in both personal and professional contexts"*
> (Digital Education Council, 2025)

The Digital Education Council definition combines effective use and critical assessment. It does not treat AI literacy as simple familiarity with AI tools, but as the ability to use them ethically, evaluate their outputs, and maintain human judgement. It also recognises that AI literacy is needed across different contexts, including personal, educational, and professional settings.

Chiu's distinction between AI literacy and AI competency

> *AI literacy refers to a foundational conceptual understanding of AI; it focuses on knowledge, critical thinking, and ethical awareness rather than technical skill*
> (Chiu, 2025)

This definition frames AI literacy primarily as a conceptual and critical capability. AI-literate individuals should be able to explain what AI systems are, identify real-world applications, and discuss their societal implications. Chiu also distinguishes AI literacy from AI competency: AI literacy refers to foundational understanding, whereas AI competency concerns the practical ability to use, engage with, interact with, develop, or manage AI systems in real-world contexts. This distinction is useful because it separates conceptual understanding from practical performance, while still recognising that the two are closely related.

Hackl et al. (2026)

Hackl et al. (2026) offer a broad, multidimensional definition. They distinguish AI literacy from media, data, and computational literacy by arguing that AI literacy focuses specifically on interaction with and understanding of AI technologies. Their definition is also explicitly context-sensitive, since the weight of technical, ethical,

> *AI Literacy in Higher Education refers to the ability to critically engage with AI technologies, understand their societal and ethical implications, and apply them responsibly. It integrates knowledge, skills, and attitudes across technical, applicational, critical thinking, ethical, social, integrational, and legal dimensions, with variations in emphasis depending on the disciplinary context*
> (Hackl et al., 2026)

social, legal, and applicational dimensions may vary depending on the disciplinary setting.

Ng et al. (2021) and earlier definitions

> *AI literacy is a set of competencies that enables individuals to critically evaluate AI technologies; communicate and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace*
> (Long & Magerko, 2020, cited in Ng et al., 2021)

Ng et al. (2021) review several earlier definitions and use them to conceptualise AI literacy as a multidimensional construct. The definition by Long and Magerko is particularly comprehensive because it combines critical evaluation, communication, collaboration, and practical use. It also makes clear that AI literacy is not limited to school or technical contexts, but extends to everyday life and work.

Chee et al. (2025)

> *AI literacy is a comprehensive set of competencies enabling individuals to critically evaluate AI technologies, effectively communicate and collaborate with AI, and utilize AI as a tool in various settings*
> (Chee et al., 2025)

Chee et al. (2025) adopt and operationalise Long and Magerko's definition. Their contribution is relevant because they connect this definition with differentiated learner groups and competency needs. In this perspective, AI literacy may vary across educational stages and professional contexts: school students, higher education students, and workers may require different combinations of foundational knowledge, ethical awareness, technical understanding, problem solving, and career-related competencies.

Synthesis

Across the reviewed sources, AI literacy can be understood as a broad and context-dependent set of knowledge, skills, attitudes, and understanding that enables individuals to understand AI systems, use them effectively and ethically, critically evaluate their outputs and implications, and act responsibly in AI-mediated

contexts. These definitions portray AI literacy as a broad, interdisciplinary construct. It includes conceptual understanding, ethical awareness, critical evaluation, and the ability to interact with, manage, or even create AI systems. It is also increasingly framed as role-sensitive and context-dependent, especially in regulatory and organisational settings where AI systems are used by non-technical professionals.

3. Overview of main AI literacy frameworks

This section introduces some key AI literacy frameworks that have been selected among the reviewed sources. Each framework domain or area is briefly introduced and defined to guide the following cross-case analysis.

3.1 UNESCO AI Competency Framework for Students

The UNESCO AI competency framework for students is structured around 4 main competency domains, cross-referenced with 3 progression levels (Understand, Apply, and Create), forming a matrix of 12 total competency blocks (**Figure 2**).

Human-centred mindset

This aspect focuses on students' values, beliefs and critical thinking regarding the role of humans in AI-driven societies. It examines whether AI is appropriate for a given purpose, how humans should interact with it, and what responsibilities individuals and institutions hold.

[Understand] Human agency. Students recognize that AI is human-led and understand the implications of maintaining human control over data, design, and decision-making.

[Apply] Human accountability. Students understand the legal and social responsibilities of AI creators and users, especially in high-stakes decisions.

[Create] Citizenship in the AI era. Students critically assess AI's societal impact and embrace civic responsibility to promote inclusive, sustainable AI development.

Ethics of AI

This aspect covers ethical reasoning, value judgements and socio-emotional skills needed to navigate and apply ethical principles and regulations across the AI life cycle.

[Understand] Embodied ethics. Students internalize principles such as do no harm, proportionality, non-discrimination, sustainability, human determination, and transparency.

[Apply] Safe and responsible use. Students practise responsible AI behaviours, protect data privacy, and comply with local regulations.

[Create] Ethics by design. Students apply ethical principles when designing or evaluating AI systems and contribute to adapting AI regulations.

AI Techniques and Applications

This aspect represents the conceptual and operational knowledge needed to understand how AI works and to use AI tools meaningfully.

[Understand] AI foundations. Students learn basic concepts of data, algorithms, machine learning types, and the AI life cycle.

[Apply] Application skills. Students acquire transferable skills in data handling, programming, and evaluating open-source AI tools.

[Create] Creating AI tools. Students customize datasets, adapt AI models, and develop simple AI applications while integrating ethical and human-centred considerations.

AI System Design

This aspect targets students with deeper interest in AI, focusing on engineering thinking and the full AI development cycle.

[Understand] Problem scoping. Students learn to determine whether AI should be used, define problem boundaries, and assess data and resource needs.

[Apply] Architecture design. Students configure basic AI system architectures, selecting datasets, algorithms, models, and interfaces.

[Create] Iteration and feedback loops. Students test, optimize or reconfigure AI systems, evaluate societal and environmental impacts, and decide when an AI system should be improved or shut down.

Competency aspects	Progression levels		
	Understand	Apply	Create
• Human-centred mindset	• Human agency	• Human accountability	• Citizenship in the era of AI
• Ethics of AI	• Embodied ethics	• Safe and responsible use	• Ethics by design
• AI techniques and applications	• AI foundations	• Application skills	• Creating AI tools
• AI system design	• Problem scoping	• Architecture design	• Iteration and feedback loops

Figure 2. AI competency framework for students (UNESCO, 2024)

3.2 AILit Framework

The AILit Framework adopts the same four domains defined by the OECD: engaging with AI, creating with AI, managing AI, and designing AI. However, the two frameworks serve different purposes. The OECD model provides a high-level conceptual definition of AI literacy for citizens and policymakers, whereas the AILit Framework translates these domains into 22 detailed competences distributed across four domains (**Figure 3**), including knowledge, skills, attitudes, and classroom scenarios for primary and secondary education. In this sense, AILit explains how AI literacy can be taught and developed in K-12 settings.

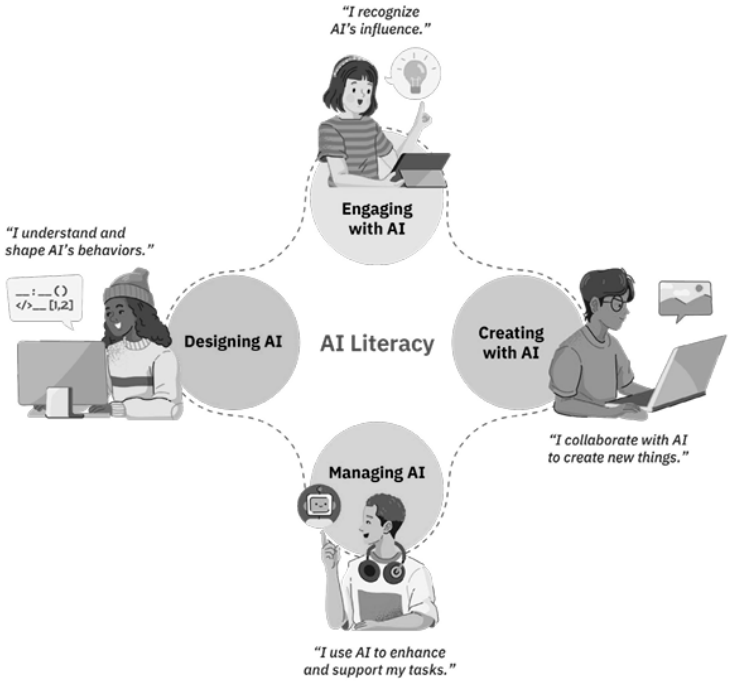

Figure 3. The four domains of AILit framework.

Engage with AI

This domain focuses on recognising when AI is involved and evaluating its outputs in terms of accuracy, bias, and relevance. Competences 1-7 belong to this area, including *recognise AI's role and influence in different contexts*, *evaluate whether AI outputs should be accepted, revised or rejected*, *explain how AI could be used to amplify societal biases*. They address the ability to identify AI systems, understand their technical foundations, and critically assess the accuracy, bias, ethical implications, and potential limitations of AI-generated outputs.

Create with AI

This domain concerns the use of AI for ideation, content generation, and problem-solving. Competences 8-12 fall under this area, including *visualise, prototype and*

combine ideas using different types of AI systems, and *direct generative AI systems to elicit feedback, refine results and support reflection*. They focus on collaborating with AI systems in creative and problem-solving processes, refining AI-generated outputs, and addressing issues related to authenticity, authorship, and intellectual property.

Manage AI

This domain addresses the delegation of routine tasks to AI in order to amplify human work and allow people to focus on higher-impact activities. Competences 13-17 are part of this area, including *choose an appropriate AI approach for a task by comparing how different AI systems operate and what they are best suited to do*, and *monitor and evaluate AI use throughout a problem solving process*. They involve deciding when AI use is appropriate, distributing tasks between humans and AI systems, guiding AI systems effectively, and establishing responsible guidelines for AI use.

Design AI

This domain focuses on understanding how AI systems are built and how their design choices shape their impact. It does not necessarily require learners to build AI models themselves. Competences 18-22 belong to this area, including *investigate how an AI system is intended to work, whom it is designed for and what its limitations are*, and *improve AI systems to address and promote human well-being and societal benefit*. They address how data, modelling choices, and design decisions influence AI behaviour, and how to evaluate and communicate an AI system's purpose, users, limitations, and potential consequences.

3.3 Digital Education Council (DEC) Framework

The DEC framework identifies five AI Literacy Dimensions; each articulated through a guiding question that clarifies the core competence it aims to develop (**Figure 4**).

Understanding AI and Data

How does AI work? This domain concerns the essential knowledge needed to understand how AI systems function and how data is collected, processed, and interpreted. It equips individuals to recognise the implications of AI-generated outputs, understand system strengths and limitations, and make informed decisions about when and how to use AI tools.

Critical Thinking and Judgement

How do I evaluate AI output? This domain focuses on the ability to analyse AI-generated content with rigour. It includes identifying biases, verifying information, recognising inaccuracies, and applying logical reasoning when using AI in

decision-making. The emphasis is on ensuring that human judgement remains central and that AI supports, rather than replaces, human reasoning.

Ethical and Responsible AI Use

How do I ensure AI is used ethically and responsibly? This domain addresses the principles and practices required for responsible AI adoption. It involves understanding ethical concepts such as fairness, transparency, accountability, and privacy, recognising potential risks, and applying governance frameworks. Individuals learn to use AI in ways that are compliant, trustworthy, and aligned with ethical standards.

Human- Centricity, Emotional Intelligence, Creativity

How do I ensure humans remain at the core? This domain highlights the human skills that become increasingly important in AI-mediated environments. It includes empathy, adaptability, communication, and creativity. Individuals learn to ensure that AI enhances human agency, supports inclusive practices, and aligns with social values, while also considering its impact on well-being and interpersonal interactions.

Domain Expertise

How do I apply AI in a specific context? This domain focuses on applying AI knowledge within a particular academic or professional field. It includes understanding how AI is used in the discipline, evaluating its relevance and limitations, and integrating AI tools to improve practice. It also requires navigating domain-specific ethical, regulatory, and operational considerations.

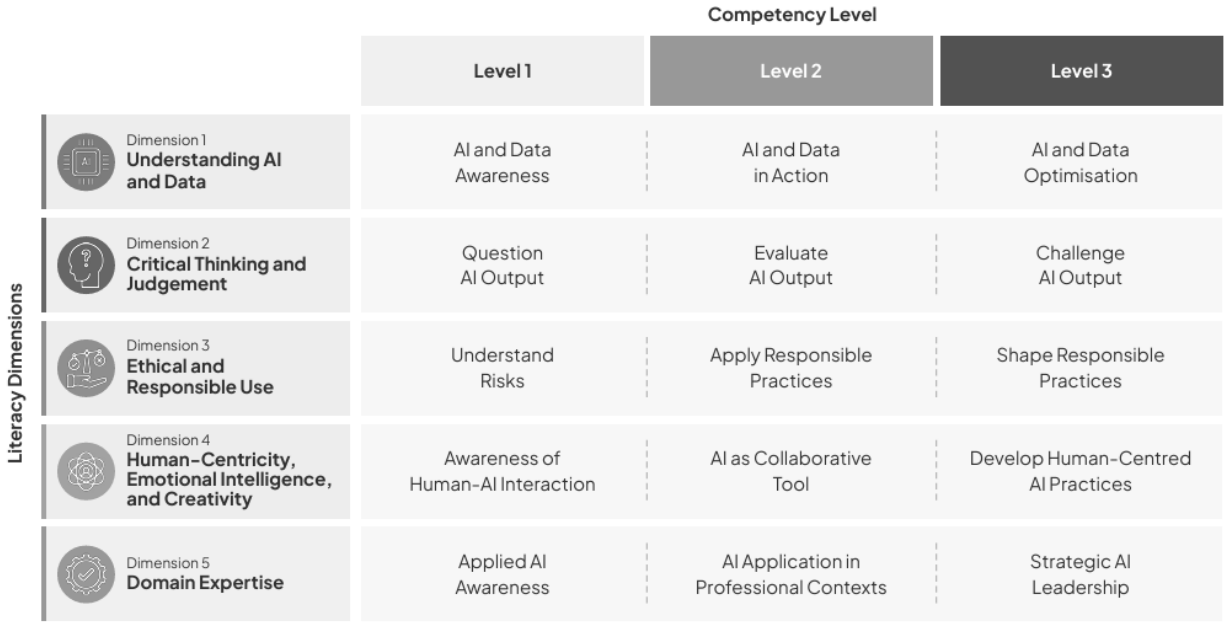

Figure 4. Digital Education Council AI Literacy Framework.

As we can observe in Figure 4, each of the five DEC AI Literacy Dimensions progresses across three competency levels. **Level 1** represents foundational awareness, where individuals begin to recognise key concepts and risks related to AI. **Level 2** reflects practical application, in which users start to evaluate AI outputs, apply responsible practices, and integrate AI tools into real tasks. **Level 3** corresponds to advanced, strategic mastery, where individuals optimise AI use, challenge AI-generated insights, shape ethical guidelines, and demonstrate leadership in human-centred and domain-specific AI adoption. Together, these levels show a clear developmental pathway from basic understanding to expert, responsible, and context-aware AI proficiency.

3.4 Stanford University Framework

Stanford University proposes a framework identifying four competency domains (**Figure 5**). For each of the four domains, a set of objectives is identified, and these are in turn divided into three groups: **Novice-level** example objectives, **Intermediate-level** example objectives, and **Advanced-level** example objectives.

Functional literacy

How does AI work? Functional AI literacy refers to understanding how AI systems work, being able to use common AI tools, and staying aware of developments in the field. At a basic level, it involves accessing AI tools, using simple prompts, and learning key concepts such as terminology and the role of data in AI training. At a more expert level, it involves evaluating the strengths and limitations of AI technologies and using more sophisticated prompting techniques. At the highest level, it includes customizing AI tools, creating support resources, and contributing to shared knowledge systems within a community.

Ethical literacy

How do we navigate the ethical issues of AI? Ethical AI literacy focuses on understanding and addressing the ethical implications of using AI technologies responsibly. At a foundational level, it involves recognizing issues such as accuracy, bias, reliability, academic integrity, privacy, and accessibility. As understanding grows, learners critically examine broader societal impacts, including misinformation, labour practices, and military applications of AI. At advanced levels, they adopt and promote ethical practices in AI use and contribute to collective standards.

Rhetorical literacy

How do we use natural and AI-generated language to achieve our goals? Rhetorical AI literacy refers to the ability to use language effectively to achieve goals and to understand the relationship between human and AI-generated text. At a basic level, it involves recognizing how tone, structure, and word choice

influence communication and learning how to write effective prompts. It also includes analysing AI outputs and identifying patterns in how AI uses language. As understanding grows, users improve their prompting strategies and adapt AI responses to different contexts. At advanced levels, they see AI use as a form of collaboration, balancing human expression with AI support.

Pedagogical literacy

How do we use AI to enhance teaching and learning? Pedagogical AI literacy focuses on using knowledge of teaching and learning to effectively integrate AI into education. It begins with understanding learning theories, teaching strategies, and inclusive practices, along with exploring AI educational tools. As it develops, educators apply evidence-based methods to enhance critical thinking, problem-solving, and student well-being using AI support. They also identify risks where AI may weaken learning and adjust their teaching accordingly. At advanced levels, they combine functional, ethical, and rhetorical AI knowledge to improve instruction.

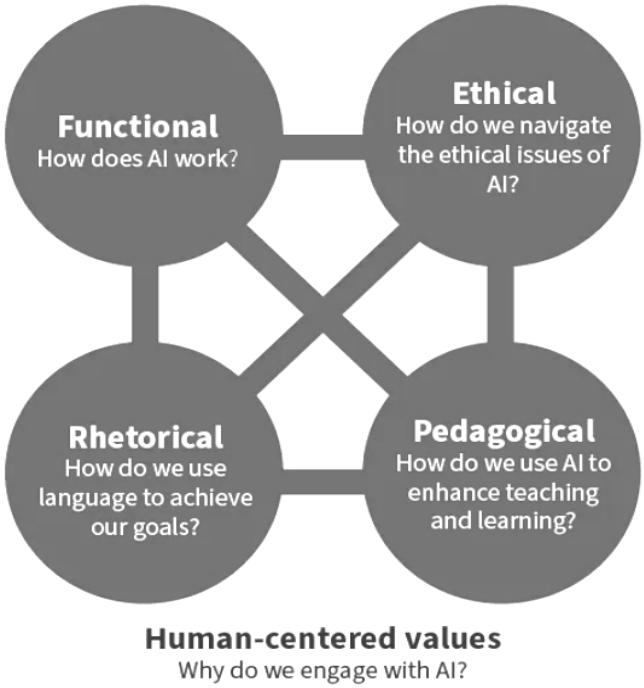

Figure 5. Stanford Teaching Commons, Understanding AI Literacy, Stanford University.

3.5 Ng et al. (2021) Framework

Ng et al. (2021) propose a framework that organises AI literacy around four main domains: Know and Understand AI, Use and Apply AI, Evaluate and Create AI, and AI Ethics. The framework is especially useful because it connects these domains to Bloom's Taxonomy (Bloom et al., 1956), presenting AI literacy as a progressive

learning process that moves from basic knowledge to higher-order thinking. **Figure 6** illustrates this progression, from recalling and explaining AI concepts to applying AI tools, evaluating AI outputs, and designing or developing AI applications.

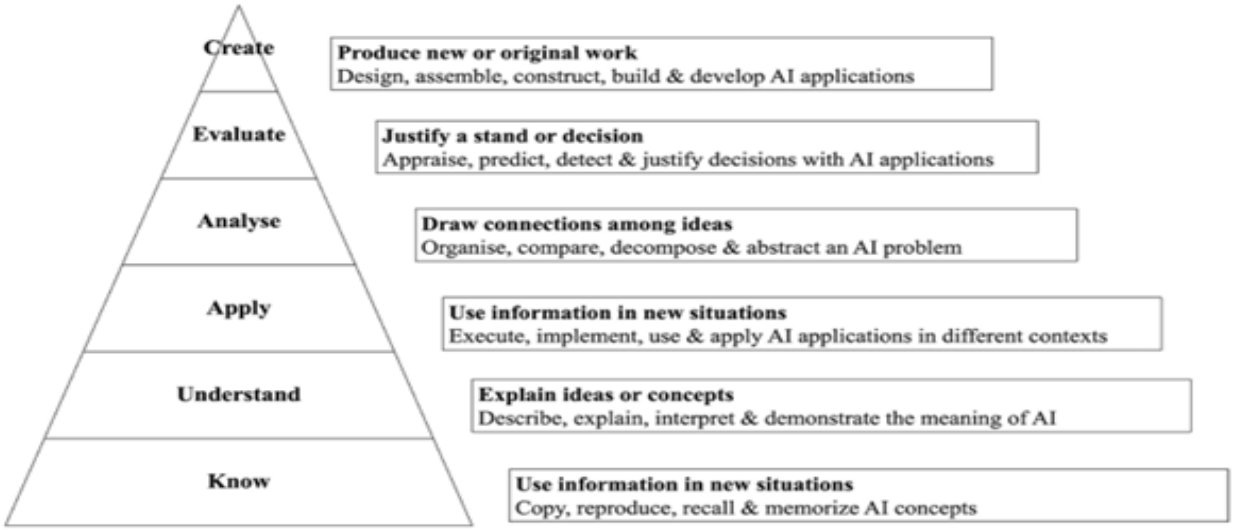

Figure 6. Bloom's Taxonomy and AI literacy (Ng et al., 2021).

Know and Understand AI

This domain refers to the foundational knowledge needed to understand AI. It includes knowing what AI is, recognising where it is used, and understanding basic concepts such as data, algorithms, machine learning, and intelligent applications. In Bloom's Taxonomy, this domain is associated with the levels of Know and Understand, where learners recall AI-related concepts and explain their meaning.

Use and Apply AI

This domain focuses on the practical use of AI tools in different contexts. It includes applying AI applications to solve problems, support decision-making, and complete tasks. In Bloom's Taxonomy, this domain corresponds to the level of Apply, where learners use AI knowledge in real situations.

Evaluate and Create AI

This domain refers to more advanced forms of AI literacy. It includes analysing AI problems, comparing possible solutions, assessing the quality and reliability of AI outputs, and producing new or original work with AI applications. In Bloom's Taxonomy, this domain is linked to the levels of Analyse, Evaluate, and Create, which involve drawing connections among ideas, justifying decisions, and developing AI-related outputs.

AI Ethics

This domain cuts across the whole framework. It concerns the ability to understand and address ethical issues related to AI, including bias, fairness, accountability, transparency, privacy, and responsible use. Ethical awareness is therefore not treated as a separate final step, but as a dimension that should accompany the whole learning process, from basic understanding to advanced AI use and creation.

3.6 Chee et al. (2025) Framework

Based on their analysis, the authors produced a framework that identifies 8 core competencies:

AI Device and Software/Application/Platform Operations

Build a foundational understanding of AI while learning to use common AI devices, software, and applications, thereby establishing a basis for further AI learning and development. In the AI era, basic AI skills are increasingly regarded as essential competencies, much like the everyday use of smartphones and laptops by the general population.

Data and Algorithm Literacy

Understanding data, algorithms, AI logic, and system functioning.

Problem Solving

Using AI tools and knowledge to solve problems and support decisions.

Communication and Collaboration

This competency includes human-to-tool collaboration through AI, such as engaging in team-based discussions to adapt changing roles.

AI Ethics

Recognising opportunities, risks, bias, privacy issues, and ethical implications of AI.

Career-Related Competences

Applying AI tools and evaluating AI outputs within specific professional or disciplinary contexts.

AI-Based Content Creation

Using AI systems to generate, edit, co-create, and improve digital content such as text, images, media, or other outputs.

Affective Competencies in Using AI

Developing self-efficacy, confidence, awareness of AI limitations, willingness to engage with AI, and the ability to maintain human judgment and agency.

Not all learner groups are expected to develop the same AI literacy competences, as the skills required to interact effectively with AI evolve across educational stages and professional contexts. According to Chee et al. (2025), K-12 learners primarily need to build competences related to *AI ethics*, *data and algorithm literacy*, and *basic device and software operations*, reflecting the need for foundational understanding and responsible use. In higher education, the emphasis shifts toward more advanced abilities, with priority given to *data and algorithm literacy*, *problem solving*, and *career-related competences*, supporting students as they engage with AI in discipline-specific and pre-professional contexts. For the workforce, the most relevant competences include *data and algorithm literacy* and *career-related competences*, alongside *problem solving*, as workers must interpret data, use AI tools strategically, and make informed decisions within their professional roles. Together, these variations highlight that AI literacy is a developmental continuum, requiring differentiated competences that align with learners' maturity, educational goals, and real-world responsibilities.

3.7 Hackl et al. (2026) Framework

These authors observe that the more recent conceptualizations of AI literacy incorporate more comprehensive dimensions including ethical, social, and practical ones. They include seven core areas, detailed below and in **Figure 7**.

Technical Knowledge and Skills

Understanding fundamental AI principles, including algorithms, data processing, and computational mechanisms.

Application Proficiency

Effectively utilizing AI technologies across diverse contexts to solve practical problems and improve workflows, and understanding various AI tools' strengths and limitations.

Critical Thinking Ability

The ability to analyse, evaluate, and critically assess AI systems, their capabilities, limitations, and implications for specific use cases.

Integration Skills

The ability to effectively incorporate and adapt AI technologies into diverse digital environments and workflows.

Legal and Regulatory Knowledge

Includes the creation of new, AI-specific legislation and the application of already existing technology-neutral legal frameworks.

Ethical Awareness and Reasoning

The ability to identify, evaluate, and address ethical implications of AI technologies across multiple levels.

Social Impact Understanding

The ability to comprehend and critically evaluate the multifaceted effects of AI technologies on societal structures and human interactions.

These seven dimensions are then explicitly linked to the cognitive processes of Bloom's Taxonomy: unaware, beginner, intermediate, expert.

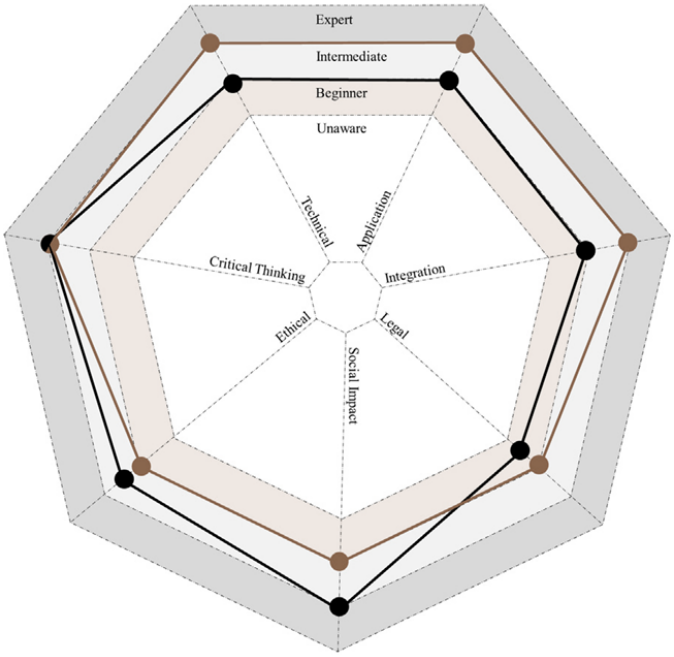

Figure 7. AI literacy Heptagon with examples of profiles (Hackl et al., 2026).

3.8 Comparative analysis of AI literacy domains

Table 1 compares the AI literacy frameworks analysed and identifies common domains, defined according to the following definitions.

AI technical foundations

"Understanding fundamental AI principles, including algorithms, data processing, and computational mechanisms" (Hackl et al., 2026), and "awareness of the ongoing development of AI technology." (Understanding AI Literacy, Stanford University).

Human centricity of AI

"Values, beliefs and critical thinking skills, applied to the examination of whether AI is fit for purpose, whether its use is justified, how humans should interact with it,

and what responsibilities individuals and institutions should take on to contribute to the building of safe, inclusive and just AI societies." (UNESCO, 2024).

Critical thinking

"The ability to use language effectively to achieve goals and [...] to write effective prompts" (Stanford university) and to "understand the importance of verifying AI-driven insights. Recognise when AI -generated content may oversimplify or misrepresent concepts." (DEC AI Literacy Framework: AI Literacy for All, 2025).

Creating AI systems

Creating and configuring "*basic AI system architectures*" (UNESCO, 2024).

Understanding AI social impact

The "ability to comprehend and critically evaluate the multifaceted effects of AI technologies on societal structures and human interactions" (Hackl et al., 2026) and "to promote responsible and inclusive design and use of AI for sustainable development." (UNESCO, AI competency framework for students, 2024).

Managing AI ethical issues

"This domain includes understanding ethical issues related to AI and practices for the responsible and ethical use of AI tools." (Understanding AI Literacy, Stanford University).

Domain Expertise

"Identify AI trends and their impact on your future career. Understand how AI is changing the industry and what is expected by young professionals." (DEC AI Literacy Framework: AI Literacy for All, 2025) and "to effectively incorporate and adapt AI technologies into diverse digital environments and workflows" (Hackl et al., 2026).

Table 1. Comparative analysis of AI literacy domains.

	AI technical foundations	AI Human-centricity	Critical thinking	Creating AI systems	Understanding AI social impact	Managing AI ethical issues	Spec. domain expertise
UNESCO	AI techniques and applications	Human centred mindset	Human centred mindset	AI System Design	Human centred mindset	Ethics of AI	-
AILit	Engaging with AI	-	Engaging with AI	Creating with AI	Engaging with AI	Creating with AI	-
DEC	Understanding AI and Data	Emotional intelligence, creativity	Critical thinking and judgement	-	-	AI ethical and responsible Use	Domain Expertise
Stanford University	Functional literacy	-	Rhetorical literacy	Functional literacy	Ethical literacy	Ethical literacy	Pedagogical literacy
Ng et al. (2021)	Know and Understand AI	-	Evaluate and Create AI	Evaluate and Create AI	-	AI Ethics	-

Chee et al. (2025)	Data and Algorithm Literacy	Affective competencies for AI	Data and Algorithm Literacy	AI-Based Content Creation	-	AI Ethics	Career-Related Competences
Hackl et al. (2026)	Technical skills and knowledge	-	Critical Thinking Ability	-	Social impact understanding	Ethical Awareness, reasoning	Application proficiency

These definitions will guide the identification of AI literacy domains for HEALTH-LOG-AI final framework.

4. Competency scales

This section briefly analyses the traditional competency scales and frameworks adopted as reference for ensuring that the resulting AI literacy frameworks of HEALTH-LOG-AI project are recognized and standardized at the European level.

4.1 The KSA competency framework

The KSA framework describes competence through three interrelated dimensions: knowledge, skills, and attitudes. In vocational education and training, competence is not usually understood as the possession of isolated information or technical abilities, but as the capacity to mobilise different resources in a specific professional situation. Knowledge, skills, and attitudes are therefore closely connected and should be considered together when defining learning outcomes and professional profiles (Baartman & de Bruijn, 2011).

A useful way to organise these dimensions is to distinguish between different areas of competence. Colombari and Neirotti (2022) distinguish between domain, transversal, and digital competence components in the context of digitalised work. Domain competencies refer to the technical and contextual expertise of a specific professional field. Transversal competencies refer to human and organisational capabilities such as communication, teamwork, learning orientation, problem solving, and continuous improvement. Digital competencies refer to the knowledge, skills, and attitudes needed to work with data, digital tools, information systems, and digitally mediated processes.

This produces a matrix in which knowledge, skills, and attitudes can be crossed with domain, transversal, and digital competence areas (**Table 2**). The same logic is also consistent with the idea of π-shaped competence profiles, where professionals need depth in more than one area, together with transversal capabilities that connect them. For AI literacy, this is relevant because competence should not be defined only as digital expertise. It also requires domain understanding, the ability to work across functions and roles, and a critical and responsible attitude toward the use of AI.

Knowledge

Knowledge refers to the theoretical and factual understanding required to act competently in a given context. It includes concepts, principles, rules, terminology, procedures, and contextual information that allow individuals to understand what they are doing and why.

In competence frameworks, knowledge can take different forms. It may include domain knowledge, such as the principles, processes, regulations, and terminology of a specific field. It may include transversal knowledge, such as basic understanding of organisational processes, communication dynamics, decision-making, innovation, or continuous improvement. It may also include digital knowledge, such as data, information systems, algorithms, statistics, cybersecurity, or the functioning of digital and AI-enabled tools.

For AI literacy, knowledge may include understanding what AI is, how data are used, what machine learning systems do, why AI outputs may be uncertain, and what risks are associated with automation, prediction, bias, privacy, or lack of transparency. At a basic level, this may involve recognising that a system uses AI and understanding key terminology. At a more advanced level, it may involve understanding how data quality, model assumptions, and contextual changes can affect the reliability of AI-generated outputs.

Skills

Skills refer to the ability to apply knowledge in practice. They include cognitive skills, such as analysing, interpreting, comparing, evaluating, and solving problems, and practical skills related to the use of tools, methods, procedures, and technologies. Skills are especially important in competence-based education because they make competence observable: they describe what a learner or professional is able to do.

Examples of skills may include reading and interpreting information, using digital tools, preparing a technical report, communicating results, working in teams, solving operational problems, comparing alternatives, or adapting a procedure to a new situation. In AI literacy, skills may include using AI tools, formulating effective prompts, checking the consistency of AI outputs, comparing AI-generated suggestions with other sources of information, identifying possible errors, and deciding when human review is needed.

Skills can also be classified as domain, transversal, or digital. Domain skills are linked to the execution of tasks in a specific professional area. Transversal skills, such as communication, collaboration, problem solving, and decision-making, can be transferred across contexts. Digital skills concern the ability to use, interpret, and manage digital tools, data, and information systems.

Attitudes

Attitudes refer to the dispositions, values, and behavioural orientations that influence how knowledge and skills are used in practice. They include openness to learning, responsibility, critical thinking, attention to detail, adaptability, confidence, collaboration, and willingness to engage with feedback. In vocational competence, attitudes are important because professional action is shaped not only by what individuals know or can do, but also by how they approach uncertainty, change, responsibility, and interaction with others.

In AI literacy, relevant attitudes include curiosity toward new technologies, critical judgement toward automated outputs, responsibility in the use of data, awareness of ethical implications, and willingness to keep human judgement active when using AI systems. For example, two users may have similar knowledge of an AI tool and similar ability to use it, but one may accept an output mechanically while another verifies it, questions possible errors, and considers whether it is appropriate for the situation. This difference belongs to the attitudinal dimension of competence.

Table 2. KSA framework crossed with domain, transversal, and digital competence areas.

	Domain	Transversal	Digital
Knowledge	Knowledge of field-specific concepts, processes, terminology, standards, and regulations.	Knowledge of organisational processes, communication dynamics, decision-making, collaboration, and continuous improvement.	Knowledge of data, information systems, algorithms, statistics, cybersecurity, and the functioning of digital and AI-enabled tools.
Skills	Ability to apply domain-specific methods, procedures, tools, and professional judgement to concrete tasks.	Ability to communicate, collaborate, solve problems, compare alternatives, adapt to changing situations, and support decisions.	Ability to use digital tools, interpret data, interact with AI systems, check outputs, and manage digitally mediated processes.
Attitudes	Responsibility, attention to quality, sensitivity to field-specific risks, and awareness of professional standards.	Openness to learning, collaboration, adaptability, critical thinking, proactivity, and willingness to engage with feedback.	Data-driven mindset, critical judgement toward automated outputs, awareness of digital risks, and responsible use of AI and data.

4.2 The EQF framework

The European Qualifications Framework covers 8 types and levels of qualifications, with the use of learning outcomes. It serves as a translation tool between different national qualifications frameworks to clarify what a person knows, understands and is able to do. It is considered a key tool for **promoting transparency, comparability, and recognition of qualifications and their levels across countries**, fostering lifelong learning and mobility throughout Europe.

HEALTH-LOG-AI aims to contribute with an holistic AI literacy framework in line with the continuous updates in education and training systems, which are continuously evolving to address the shifting demands of labour markets and

societal needs – as highlighted by Cedefop, the European Centre for the Development of Vocational Training. The delivery of VET courses needs to consider the **learning outcomes**, i.e. the statements defining the content and profile of what a learner is **expected to know, understand, and be able to do**. They are fundamental as they act as a common language regarding the content and profile of VET programmes and qualifications.

In EQF, there are 8 levels ordered according to the level of proficiency, with level 1 the lowest and 8 the highest level. Each learning outcome is defined in terms of knowledge, skills, and responsibility and autonomy, i.e., the ability of a learner to apply knowledge and skills autonomously and with responsibility. **Table 3** summarises the 8-level descriptors of the EQF framework.

Table 3. Synthesized progression of EQF levels.

	Knowledge	Skills	Responsibility and autonomy
Level 1	Basic general knowledge.	Basic skills for simple tasks.	Works or studies under direct supervision in structured contexts.
Level 2	Basic factual knowledge in a field of work or study.	Basic cognitive and practical skills for routine tasks and simple problem solving.	Works or studies under supervision with some autonomy.
Level 3	Knowledge of facts, principles, processes, and general concepts in a field.	Uses basic methods, tools, materials, and information to complete tasks and solve problems.	Takes responsibility for task completion and adapts behaviour to circumstances.
Level 4	Factual and theoretical knowledge in broad contexts within a field.	Uses cognitive and practical skills to generate solutions to specific problems.	Exercises self-management and supervises routine work of others in changing but predictable contexts.
Level 5	Comprehensive, specialised knowledge and awareness of its boundaries.	Develops creative solutions to abstract problems using a broad range of skills.	Manages and supervises activities in contexts subject to unpredictable change.
Level 6	Advanced knowledge of a field, including critical understanding of theories and principles.	Demonstrates mastery and innovation in solving complex and unpredictable problems.	Manages complex activities or projects and takes responsibility for decision-making and professional development.
Level 7	Highly specialised knowledge, including critical awareness at the interface between fields.	Uses specialised problem-solving skills to develop new knowledge and integrate knowledge from different fields.	Manages and transforms complex and unpredictable contexts; contributes to professional knowledge and team performance.
Level 8	Knowledge at the most advanced frontier of a field and at the interface between fields.	Uses the most advanced and specialised skills to solve critical problems and redefine existing knowledge or practice.	Demonstrates substantial authority, autonomy, innovation, integrity, and sustained commitment to new ideas or processes.

HEALTH-LOG-AI considers this framework to develop AI-focused learning modules and to ensure skill acquisition that is standardized and recognized at the European level thanks to the definition of learning outcomes and mastery levels, representing different stages of acquisition or development of the skill.

4.3 Other reference frameworks for competency scaling

Beyond the KSA and EQF frameworks, different approaches have been used to describe competence progression in vocational education, human resource

management, work psychology, and education research. These approaches vary in terminology, but they share a common objective: defining how competence develops from basic awareness or initial performance to autonomous, expert, and context-sensitive action (Tūtlys et al., 2018).

Competency scales are useful because they translate broad competence domains into levels of achievement. For each level, knowledge, skills, and attitudes can be described with increasing degrees of complexity, autonomy, responsibility, and contextual awareness. In this way, proficiency levels support both curriculum design and assessment, as they clarify what learners are expected to know, do, and demonstrate at each stage.

A common reference is the Dreyfus model of skill acquisition (Dreyfus & Dreyfus, 1980), which describes competence development through five levels: novice, advanced beginner, competent, proficient, and expert. This logic is useful when the objective is to describe how professional performance evolves with experience. At the novice level, individuals tend to follow rules and instructions. At higher levels, they become increasingly able to interpret situations, adapt their actions, make autonomous decisions, and act with expert judgement.

Another useful reference is Bloom's Taxonomy (Bloom et al., 1956), which organises learning progression according to cognitive complexity. In the AI literacy frameworks reviewed above, Bloom's logic is often reflected in scales that move from basic awareness and understanding to application, analysis, evaluation, and creation. Some AI literacy frameworks also include a preliminary unaware level, where learners have not yet developed awareness of AI systems, their uses, or their implications.

For the purposes of AI literacy, these approaches suggest that proficiency scales do not necessarily need to reproduce the eight EQF levels in full. A more practical scale may adopt three to five levels, provided that the progression remains clear. For example, a simplified four-level structure could distinguish between:

1. **Unaware** (the learner has little or no awareness of AI and its implications)
2. **Beginner** (the learner recognises basic AI concepts and understands simple uses and risks)
3. **Intermediate** (the learner applies AI tools, interprets outputs, and identifies limitations in practical contexts)
4. **Advanced** (the learner evaluates AI use critically, adapts it to complex situations, and contributes to responsible implementation)

Alternatively, a five-level structure may follow the Dreyfus logic more closely: novice, advanced beginner, competent, proficient, and expert. This option offers more granularity, but it may also be more complex to operationalise and assess. A shorter scale can be easier to communicate and use in training, especially when

the target groups are non-expert professionals. For this reason, the choice of proficiency scale should balance conceptual precision and practical usability. The scale should be detailed enough to distinguish meaningful stages of AI literacy development, but simple enough to support training design, self-assessment, and later competency mapping.

5. Conclusions and recommendations

This deliverable reviewed existing AI literacy definitions, frameworks, and competency scales in order to provide a foundation for the development of the HEALTH-LOG-AI competency framework and profiles for non-expert healthcare logistics professionals. Based on the analysis, the following recommendations should guide the next steps of WP2.

Adopt a broad definition of AI literacy beyond technical tool use. AI literacy should be defined as a broad and interdisciplinary construct that includes conceptual understanding, ethical awareness, critical evaluation, and the ability to interact with, manage, or, in some cases, create AI systems. This definition should avoid reducing AI literacy to technical knowledge or tool use alone.

Use the recurring AI literacy domains as the structure of the framework. The competency framework should consider the main domains identified across the reviewed literature: AI technical foundations, human-centricity of AI, critical thinking, creating AI systems, understanding AI social impact, managing AI ethical issues, and specific domain expertise. These domains provide a common basis for organising the competencies to be developed in the following WP2 activities.

Link domain expertise to healthcare logistics applications identified in D2.2. The domain of specific domain expertise should be connected with the existing and potential applications of AI in healthcare logistics, as analysed in deliverable D2.2. This integration will allow the framework to move from a general understanding of AI literacy to competencies that are relevant for the professional profiles targeted by HEALTH-LOG-AI.

Define 3 to 5 proficiency levels aligned with learning outcomes and the EQF. The framework should include 3 to 5 proficiency levels for AI literacy competencies. These levels should be expressed through learning outcomes, defining what healthcare professionals are expected to know, understand, and be able to do at each stage. The EQF should guide this process by supporting comparability and recognition of HEALTH-LOG-AI training across European countries, especially through the dimensions of knowledge, skills, responsibility, and autonomy.

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