

Beyond STEM: An Educational Framework Proposal for AI Literacy in Humanities Higher Education

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Abstract

Artificial Intelligence (AI) is rapidly transforming higher education, research practices, and professional environments across all academic disciplines. While substantial efforts have been devoted to promoting AI literacy within Science, Technology, Engineering, and Mathematics (STEM) education, comparatively little attention has been paid to Humanities programs, despite the growing relevance of AI in cultural heritage, communication, education, historical research, philosophy, linguistics, and the social sciences. Existing educational initiatives frequently emphasize technical competencies such as programming or machine learning, overlooking the distinct epistemological needs and disciplinary perspectives of Humanities students. As Generative AI systems become increasingly accessible through natural language interaction, the capacity to critically understand, evaluate, and responsibly employ AI has become more important than the ability to develop AI systems themselves.

This paper proposes the HALF Framework, an educational framework specifically designed to promote AI literacy among Humanities students in higher education. The framework adopts a human-centred and competence-based perspective, integrating conceptual understanding of AI technologies with ethical reasoning, critical evaluation, human-AI collaboration, and domain-specific applications. Rather than positioning Humanities students as passive users of AI technologies, the framework promotes their active participation in shaping the societal, cultural, and ethical dimensions of AI adoption.

Keywords

Artificial Intelligence Literacy, Higher Education, Humanities Education, Generative AI, Digital Competence, Educational Framework, Human-Centred AI

1. Introduction

Artificial Intelligence (AI) has evolved from a specialised research domain into a pervasive technological infrastructure influencing virtually every aspect of contemporary society. Large Language Models (LLMs), generative AI systems, recommendation algorithms, and automated decision-support systems increasingly mediate communication, education, creative production, healthcare, public administration, and scientific research. Consequently, higher education institutions are confronted with the challenge of preparing graduates capable not only of using AI tools effectively but also of critically understanding their capabilities, limitations, societal implications, and ethical consequences [1].

Current discussions on AI education have largely concentrated on technical disciplines [2]. STEM curricula have rapidly integrated AI-related content into their curricula, while numerous educational frameworks primarily address algorithm design, programming, or machine learning competencies [3].

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This orientation has contributed significantly to preparing future AI developers; however, it has also generated an important educational imbalance.

Students enrolled in Humanities programmes are increasingly expected to interact with AI technologies throughout their academic and professional careers, despite receiving little or no formal education about AI itself [4]. For instance, students and researchers in the humanities may use AI-assisted tools for digital humanities tasks, such as the analysis and interpretation of large-scale cultural datasets, the evaluation of language models on humanities-oriented benchmarks, and the integration of generative AI into educational activities and problem-solving approaches [5, 6, 7, 8, 9]. Moreover, AI-based methods are being explored for the classification and analysis of complex datasets in social research, demonstrating the growing relevance of AI literacy also in interdisciplinary humanities and social science contexts [10]. Here, AI no longer represents merely a technical instrument but becomes an epistemic partner capable of influencing interpretation, knowledge production, creativity, and decision-making.

On AI-software side, contemporary generative systems have become accessible through natural language interfaces that dramatically lower technological barriers. Consequently, educational priorities shift from learning how to build AI systems toward understanding how to collaborate with them critically, responsibly, and effectively [11].

This transformation requires a reconceptualisation of AI literacy. Rather than equating AI literacy with coding skills or computational competence, a broader perspective is needed - one encompassing conceptual understanding, critical evaluation, and informed human-AI collaboration [12]. From this perspective, Humanities graduates should be empowered to become informed contributors to AI-mediated societies rather than passive consumers of AI-generated content [13]. Their disciplinary expertise in ethics, history, language, communication, philosophy, cultural analysis, and social interpretation represents an essential complement to technical AI development and is increasingly necessary for designing human-centred AI systems [14]. Recent educational research suggests that effective AI education should integrate conceptual understanding with authentic disciplinary applications. Students learn more effectively when AI concepts are contextualized within their own fields of study rather than presented through abstract technical examples. Nevertheless, systematic curricular models specifically designed for Humanities education remain remarkably limited. Although these contributions have significantly advanced the field, three common characteristics emerge. First, most frameworks remain technology-centered, emphasizing how AI systems function rather than how disciplinary communities employ them [15]. Relatively limited attention is devoted to disciplinary contextualization. Existing models generally propose universal AI competencies without explicitly considering how AI literacy should differ across academic domains [16]. This observation reflects a broader trend within higher education, where AI literacy is often conceptualized as a generic competence rather than as a discipline-sensitive educational construct [17].

The growing societal relevance of AI has been accompanied by significant policy initiatives within the European Union aimed at promoting trustworthy, human-centered, and inclusive AI adoption. The Digital Education Action Plan 2021–2027 [18] identifies digital competence as a prerequisite for social participation, lifelong learning, and employability. Although AI is not treated as an isolated discipline, the Action Plan explicitly encourages educational institutions to develop citizens' capacity to understand and critically engage with emerging digital technologies. Similarly, the Digital Competence Framework for Citizens (DigComp 3.0, [19]) conceptualizes digital competence as a combination of knowledge, skills, and attitudes distributed across five competence areas: information and data literacy, communication and collaboration, digital content creation, safety, and problem solving. Although AI is not one of the "competence areas", AI literacy is transversal to all DigComp skills. More recently, European initiatives surrounding the AI Act [20] have reinforced the necessity of widespread AI competence. The regulation introduces obligations regarding AI literacy for organizations deploying AI systems, emphasizing that individuals interacting with AI should possess an appropriate level of understanding proportional to their role and context. This policy evolution reflects a transition from considering AI literacy as an optional educational objective toward recognizing it as a societal necessity. At the international level, UNESCO's AI Competency Frameworks [21, 22] similarly advocate a human-centered approach integrating ethics, transparency, inclusion, sustainability, and critical reflection.

Rather than prioritizing technical expertise alone, UNESCO emphasizes responsible participation in AI-mediated societies. Collectively, these policy documents converge around several common principles: AI competence should extend beyond technical professions. Ethical and societal dimensions are integral components of AI education. Critical understanding is as important as operational skills. AI literacy supports democratic participation and responsible citizenship. Lifelong learning is essential because AI technologies continuously evolve. However, none of these frameworks specifically addresses the distinctive educational characteristics of Humanities programmes.

To address this challenge, we propose the Humanities AI Literacy Framework (HALF), a competence-based educational framework specifically designed for AI literacy in Humanities higher education. Drawing on UNESCO's AI competency framework for students [21], HALF is organised around four complementary domains: human-centred thinking, which emphasises human agency and accountability in AI-mediated contexts; AI ethics, which promotes responsible, safe, and critical use of AI technologies; AI foundations and applications, which develops conceptual understanding and practical competence in using AI tools; and critical understanding of AI systems, which enables students to examine how AI systems are designed, evaluated, and shaped by iterative human decisions without requiring them to become AI developers.

The proposed framework defines a structured set of competence domains, pedagogical principles, and learning outcomes intended to support curriculum design across higher education institutions, in order to provide a flexible educational architecture adaptable to diverse disciplinary contexts.

2. Instructional Design

Since sophisticated AI systems are now accessible through natural language interfaces, educational objectives increasingly concern critical collaboration with AI rather than technical development of AI systems. HALF aims to extend them by introducing a discipline-sensitive, competence-based educational architecture specifically designed for Humanities students. The framework seeks to combine conceptual understanding of AI technologies with ethical reflection, critical evaluation, human-AI collaboration, and authentic disciplinary applications, thereby supporting a more inclusive and human-centered vision of AI literacy.

This intention aligns with the concept of *vibe coding* [23], which promotes creative, intuitive, and exploratory coding practices. In this paradigm, Humanistic learners assume the role of active co-designers, articulating problems in natural language, transforming them into effective prompts, and critically overseeing the behavior of generative systems that serve as collaborative technical partners. In this new programming approach, “coders” employ AI generation tools to write code by describing their desired outcome in natural language without fully understanding the AI-generated code, primarily by describing goals in natural language and iteratively prompting, while relying on minimal review of the generated code [24].

The instructional design of HALF is grounded in the Four-Component Instructional Design (4C/ID) model proposed by van Merriënboer [25], which provides a framework for developing complex cognitive and professional competences through the integration of authentic learning tasks, supportive knowledge, procedural guidance, and targeted practice activities. In line with this approach, HALF is designed to support Humanities students in developing the ability to critically understand, evaluate, and apply Artificial Intelligence technologies within disciplinary contexts.

Supportive Information Supportive Information provides learners with the theoretical knowledge, cognitive strategies, and mental models required to perform complex tasks. Within HALF, this component aims to make AI concepts accessible to Humanities students by transforming technically complex principles into conceptual frameworks that support critical understanding. The Supportive Information component includes introductory materials on AI fundamentals with biological metaphors [26], Generative AI working, Natural Language Processing (NLP), algorithmic bias, data representation, and the limitations of AI systems. The content emphasises conceptual understanding and the development

of accurate mental models of how AI systems operate. Through explanatory resources and examples, students are guided in understanding the relationship between data, models, outputs, and decision-making processes. This component supports the development of critical AI literacy by enabling learners to move beyond a purely instrumental use of AI tools and develop awareness of their implications. The educational implementation of HALF is designed to bridge the gap between the Humanities and Artificial Intelligence by translating complex AI concepts into pedagogically accessible content tailored to Humanities students. This programme emphasises the development of conceptual, cognitive, and methodological understanding, enabling learners to critically engage with AI technologies within their disciplinary contexts.

A central objective is to demystify the "black box" [27] of AI by providing students with intuitive mental models of how AI systems operate. This approach reduces cognitive barriers for non-STEM learners while promoting informed, critical, and ethical engagement with AI. The introductory phase of the programme consists of structured learning activities that support the acquisition of fundamental AI concepts and computational thinking, establishing the conceptual foundations required for subsequent applied learning.

Learning Tasks Building upon these foundations, the programme integrates conceptual understanding with functional competencies through hands-on activities involving high-level AI development environments, such as Google Antigravity [28], an AI-assisted software development platform that delegates complex programming tasks to autonomous AI agents. The aim is to ensure that students become informed users of AI technologies who understand both their operational principles and their broader implications.

Students are involved in project-based activities in which they analyse problems, identify suitable AI applications, interact with Antigravity, and evaluate generated outputs within their disciplinary domains. Tasks may include, for example, the development of a software useful in their professional application. The complexity of learning tasks progressively increases throughout the programme, moving from guided activities focused on understanding AI concepts towards more independent projects requiring students to make informed decisions. Students develop the ability to transfer AI knowledge to real Humanities contexts and understand AI as a methodological resource along with a technological tool by engaging with authentic problems [29].

An example could involve a law student developing a software tool with Antigravity for practicing legal argumentation through simulated cases. For instance, the student may design a system that generates fictional criminal cases and asks the user to argue either for the prosecution or the defense. Before developing the software, the student must define the purpose and learning objectives of the tool, determine how cases should be generated and presented, identify the legal sources that should inform the system, and establish criteria for selecting relevant facts, legal issues, evidence, and applicable rules. The student then uses Antigravity to translate these requirements into a working prototype, iteratively testing and refining its behaviour. Critical evaluation remains central to the task. Students must assess whether the generated cases are legally coherent, whether the sources and rules used by the system are appropriate, whether important facts or alternative interpretations are omitted, and whether the system produces misleading or unsupported legal arguments.

Part-task Practice Part-task Practice focuses on the repeated practice of specific constituent skills that require automation or increased fluency. In HALF, this component supports the acquisition of fundamental operational competences necessary for effective interaction with AI systems. Activities include guided exercises on analysing training examples, evaluating AI-generated responses, and managing prompt engineering. Additional practice activities introduce students to low-code AI environments and AI-supported development tools, allowing them to experiment with AI functionalities.

Procedural Information Procedural Information provides guidance on how to perform specific actions and procedures during task execution. Within HALF, this component supports students in

effectively operating AI tools and managing AI-supported workflows. The information is delivered through tutorials, demonstrations, step-by-step instructions, and contextual guidance embedded within learning activities. These resources support students in performing practical operations such as configuring Antigravity, designing effective interactions with the systems, and optimise prompts for both effectiveness and token efficiency.

3. Methods

The validation of the HALF educational framework adopts a mixed-methods research design aimed at evaluating its effectiveness, usability, and transferability across different European higher education contexts. The methodology combines quantitative and qualitative approaches to investigate changes in students' AI literacy, conceptual understanding, critical awareness, and applied competences, while also examining the accessibility, pedagogical coherence, and usability of the developed educational materials.

The evaluation strategy is based on a pre-test/post-test design complemented by competence-based assessment of student projects, structured surveys, qualitative feedback, and cross-institutional analysis. This methodological triangulation enables the investigation of both learning outcomes and implementation processes, providing a comprehensive understanding of the educational impact of the framework.

Prior to the pilot implementation, common assessment procedures and data collection protocols will be jointly developed and standardised across partner institutions. These include pre- and post-assessment instruments, competence-based evaluation rubrics for student projects, survey questionnaires, qualitative feedback protocols, and usability indicators for digital learning materials. Shared ethical procedures and data management guidelines are established to ensure methodological consistency, comparability of results, and responsible handling of participant data.

Participants The pilot phase involves Humanities students recruited from undergraduate, graduate, and doctoral programmes across institutions. The target population consists primarily of non-technical learners with limited or no previous background in computer science, programming, or data science.

Participant recruitment follows an inclusive strategy aimed at ensuring disciplinary diversity, gender balance, and representation of different levels of prior digital competence. Baseline information regarding students' previous experience with AI technologies, digital skills, expectations, and initial AI literacy levels is collected before the intervention to characterise the sample and provide a reference point for subsequent evaluation.

In addition to students, academic staff and tutors involved participate in the implementation and monitoring of the educational activities. Their involvement supports the evaluation of both learner outcomes and the feasibility of institutional adoption of the framework.

Training of Trainers The implementation process begins with a structured Training of Trainers phase involving academic staff from the participating institutions. The objective of this phase is to strengthen educators' pedagogical, methodological, and digital competences required to deliver AI literacy education within Humanities contexts.

The training focuses on interdisciplinary teaching strategies, approaches for explaining AI concepts to non-technical learners, and methodologies for integrating AI tools into Humanities-oriented learning activities. By establishing a common instructional framework among tutors, this phase ensures coherence in programme delivery and reduces potential variability between institutional contexts.

Educational Intervention The HALF framework is implemented through a hybrid learning model combining asynchronous online modules with in-person workshops. This blended approach is designed to connect theoretical understanding of AI systems with practical application in Humanities-related contexts.

The online component introduces Supportive Information modules, while in-person workshops complement the theoretical modules through the final Learning Task. Students apply AI tools to authentic disciplinary challenges, developing AI-supported projects connected to their academic fields. These activities encourage learners to critically share ideas, evaluate, and discuss each other.

Data Collection The evaluation combines multiple sources of quantitative and qualitative evidence.

Quantitative data are collected through pre- and post-intervention assessments measuring changes in students' AI-related knowledge with the AI Competence Scale (AICS, [30]) and in their attitudes toward AI with the General Attitudes towards Artificial Intelligence Scale (GAAIS, [31]).

Also, applied competences of the students are evaluated through project-based assessment. AI-supported projects developed during the training phase are assessed through structured competence-based rubrics addressing conceptual understanding, responsible AI usage, critical reasoning, and the ability to integrate Antigravity into discipline-specific contexts.

Qualitative data are collected through student surveys to investigate students' perceptions of the relevance, clarity, accessibility, and usability of the educational materials, as well as their perceived confidence and autonomy in engaging with AI technologies.

Additional implementation indicators, including participation rates, completion rates, engagement levels, and interaction with digital learning resources, are collected to evaluate the feasibility and sustainability of the hybrid learning model.

Data Analysis Quantitative data are analysed through comparative statistical approaches examining differences between pre- and post-intervention results. The analysis focuses on changes in AI literacy levels, competence development, completion rates, and achievement of project-based learning outcomes.

Qualitative data are analysed through thematic analysis [32] to identify recurring patterns related to learner experience, perceived usefulness, accessibility of materials, confidence development, and the relationship between theoretical knowledge and practical application.

Furthermore, cross-institutional comparisons are conducted to assess the consistency of outcomes and evaluate the adaptability of the HALF framework across different cultural and educational environments.

4. Expected Results

The evaluation of HALF is expected to provide evidence regarding the effectiveness of the framework in enhancing AI literacy among Humanities students. Based on the pre- and post-intervention assessments, the expected results include an improvement in students' understanding of fundamental AI concepts, increased awareness of AI capabilities and limitations, and enhanced ability to critically interpret AI-generated outputs. The comparison between baseline and post-training measures, including the AICS and the GAAIS, is expected to demonstrate changes in both AI-related knowledge and students' perceptions of AI.

At the level of applied competences, the project-based assessment is expected to show that students are able to integrate Antigravity into discipline-specific activities while maintaining a critical and responsible approach.

The qualitative analysis of student feedback is expected to highlight the perceived relevance, accessibility, and usability of the HALF educational materials. In particular, the evaluation is expected to provide insights into students' perceived increase in confidence, autonomy, and readiness to engage with AI technologies. Positive feedback regarding the clarity of explanations, the accessibility of technical concepts, and the coherence between theoretical modules and practical activities will support the validity of the instructional design.

Furthermore, implementation indicators are expected to provide evidence regarding the feasibility and sustainability of the hybrid learning model. Participation rates, completion rates, engagement levels, and interaction with digital resources will contribute to assessing the scalability of the framework and its suitability for adoption across different higher education contexts.

Finally, cross-institutional analysis is expected to identify common patterns and contextual differences in learning outcomes and implementation experiences across institutions. These findings will support the refinement of the HALF framework, contributing to the development of a transferable and evidence-based educational model for enhancing AI literacy among Humanities students in higher education.

5. Challenges and Future Directions

The implementation of HALF presents several challenges related to the integration of AI education within Humanities curricula. A first challenge concerns the diversity of students' prior digital competences and technological familiarity. Although the framework is designed for non-technical learners, differences in previous exposure to digital tools may influence learning trajectories and the extent to which students engage with AI-supported activities. Addressing this variability requires adaptive instructional strategies and appropriate scaffolding mechanisms to ensure equitable access to AI literacy development.

A second challenge concerns the rapid evolution of AI technologies. The continuous emergence of new models, platforms, and AI-assisted environments requires educational frameworks to remain flexible and periodically updated. While HALF focuses on transferable conceptual knowledge and critical understanding rather than on specific tools, maintaining the relevance of practical activities requires continuous monitoring of technological developments.

Furthermore, the integration of AI within Humanities contexts raises epistemological and ethical challenges. Students must learn not only how to use AI tools, but also how to critically evaluate their outputs, recognise potential biases, and understand the implications of delegating cognitive tasks to algorithmic systems. Developing this critical perspective represents a complex educational objective that requires balancing technological experimentation with reflective and disciplinary approaches. Another aspect that warrants consideration is the need for forthcoming reforms in curriculum content and in the competencies associated with the humanities.

Despite its contribution, this study presents several limitations. First, the evaluation is conducted within the context of a pilot implementation involving selected higher education institutions. Although the cross-institutional design increases the transferability of findings, the sample size and institutional contexts may limit the generalisation of results to broader educational settings.

Second, the assessment primarily focuses on short-term changes in AI literacy, perceived competence, and learning outcomes immediately after the intervention. Future evaluations should include longitudinal studies to examine whether acquired competences are maintained over time and effectively transferred to students' academic and professional activities.

Finally, the evaluation relies partly on self-reported measures, including student perceptions of confidence, usability, and attitudes towards AI. While these measures provide valuable insights into learner experience, they may be influenced by subjective perceptions. Future research should complement self-reported data with additional behavioural indicators, such as analysis of students' interaction patterns with AI tools and evaluation of AI-supported outputs in authentic contexts.

Declaration on Generative AI

During the preparation of this work, the authors used ChatGPT-5.3 in order to: Grammar and spelling check; Paraphrase and reword. After using these tools, the authors reviewed and edited the content as needed and takes full responsibility for the publication's content.

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