European Scientific Journal for Dual Higher Education

Vol. 2, No. 2 (2026)
ISSN (online): 3052-7015

PROMOTING AI LITERACY: DEVELOPMENT, IMPLEMENTATION AND INITIAL VALIDATION OF AN AI COMPETENCY MODEL FOR HIGHER EDUCATION (AICM-HE)

Nils Aschhoff [1], *Claudia Berg* [2], *Manuel Geisler* [2], *Miriam Hägerbäumer* [2*], *Vera Lenz-Kesekamp* [2] *and Miriam Stehling* [2]

[1] *Federal University of Applied Administrative Sciences, Germany*

[2] *Euro-FH University of Applied Sciences, Germany*

Keywords:
AI literacy
Competency model
Higher education
Curriculum development
Implementation strategy

Article history:
Received: 19 December 2025
Revised: 31 March 2026
Accepted: 13 April 2026

To cite this article:
Aschoff, N., Berg, C., Geisler, M., Hägerbäumer, M., Lenz-Kesekamp, V. & Stehling, M. (2026). Promoting AI Literacy: Development, Implementation and Initial Validation of an AI Competency Model for Higher Education (AICM-HE). European Scientific Journal for Dual Higher Education (ESJ DHE), 2 (2), 53-66.
https://doi.org/10.82321/07MA-34M65

Abstract
The rapid integration of Artificial Intelligence (AI) into the workplace and society requires higher education institutions to adapt their curricula in order to foster students' AI literacy. This paper presents the development, implementation, and initial validation of a comprehensive AI competency model designed for systematic and flexible integration into higher education. The AI Competency Model for Higher Education (AICM-HE) synthesises established theoretical frameworks into a multidimensional structure, comprising three content sectors (technical understanding, critical evaluation, and practical application) and three proficiency levels (basic competencies, professional use, expert level). This design avoids a "one-size-fits-all" approach and addresses the diverse needs of a heterogeneous student body. To facilitate university-wide adoption, an interactive online platform was developed as the central implementation tool. To assess practical relevance and applicability, the model and the platform were evaluated in a workshop with academic staff. The results indicate strong acceptance of the model's clarity, scientific foundation, and utility for teaching. This paper contributes a scientifically grounded and practice-validated framework that can serve as a blueprint for universities aiming to systematically embed AI competencies into their curricula and prepare graduates for an AI-driven future.

1 Introduction

The integration of Artificial Intelligence (AI) represents one of the most profound transformations of the 21st century, reshaping labour markets, educational landscapes and societal structures (OECD, 2023). In particular, the broad availability of generative AI systems has created a disruptive dynamic that challenges higher education institutions (HEIs) to move beyond reactive adjustments and proactively prepare students for an AI-centred future (Bobula, 2024; Southworth et al., 2023). This requires the systematic development of a specific set of competencies, collectively known as *AI literacy*. AI literacy is considered a key component of *Future Skills*. These encompass

* Corresponding author
E-mail address: Miriam.Haegerbaeumer@euro-fh.de

a comprehensive set of competencies, capabilities and personal qualities that enable individuals to autonomously tackle complex problems, even when operating within unfamiliar or entirely new contexts and environments (Ehlers, 2023).

According to current understandings of AI literacy, AI competence extends far beyond programming skills. Instead, it is conceived as a multidimensional construct that combines technical understanding with critical reflection and practical application. A fundamental and frequently cited definition by Long and Magerko (2020) describes AI literacy as a set of competencies that enables individuals to critically evaluate AI, communicate effectively with it, and use it as a tool. This holistic approach has been confirmed and expanded in recent research. Zhang et al. (2024) found general consensus in their umbrella review of 17 systematic reviews, emphasising that AI literacy encompasses "a range of skills that foster a comprehensive understanding of AI and enable individuals to purposefully explore AI technologies and thoughtfully assess their implications for both personal learning gains and social impact" (p. 15). Allen and Kendeou (2024) further emphasise that AI competence includes the ability to "communicate and collaborate with AI in productive ways" (p. 4). Therefore, AI literacy is a meta-competence that integrates technical understanding with critical reflection and practical application (Cox, 2024; Ng et al., 2021). Recent systematic reviews have identified consistent core constructs that underpin AI literacy frameworks. Almatrafi et al. (2024) synthesised six fundamental dimensions from their analysis of 47 articles: Recognise, Know & Understand, Use & Apply, Evaluate, Create and Navigate Ethically. These constructs provide a comprehensive foundation for understanding AI literacy, though their implementation in educational contexts varies significantly. Notably, while "Evaluate" and "Navigate Ethically" appeared in 91% of the reviewed implementations, "Create" was addressed less frequently, at only 64% (Almatrafi et al., 2024). This variation highlights the ongoing challenge of translating theoretical frameworks into practical, implementable curricula.

Building on this concept of AI literacy, HEIs face the immediate and pressing challenge of integrating AI literacy into their curricula. A didactic model is therefore needed to translate the abstract concept of AI literacy into concrete, teachable competencies at different levels of depth, suitable for a wide range of academic disciplines (Southworth et al., 2023).

Zhang et al. (2024) identified critical gaps in current approaches, including the lack of theoretical grounding in many existing tools, insufficient integration across disciplines, and inadequate faculty preparation for teaching AI concepts. Many existing AI literacy tools and curricular designs lack a solid foundation in theoretical or conceptual frameworks, limiting their pedagogical effectiveness and integration potential. Furthermore, while AI's impact extends across all disciplines, teaching materials often remain confined to STEM contexts, with insufficient integration into humanities and social sciences.

Closely linked to the necessity of integrating AI literacy into education is the need to assess the development of AI-related competencies. Consequently, the need to assess AI literacy is widely recognised in the scientific community. A recent systematic review by Lintner (2024) identified 16 different scales designed to measure AI literacy. However, the review – using the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN; Mokkink et al., 2010) to evaluate the methodological quality of the individual studies – also revealed significant weaknesses in the existing landscape of assessment tools, noting that "none of the scales showed positive evidence for all COSMIN measurement properties and most studies suffered from poor methodological rigour" (Lintner, 2024, p. 7). A particularly critical gap identified is the lack of content validation involving the target population, meaning many instruments have not been sufficiently tested for their relevance and comprehensibility among those expected to use them. Lintner (2024) found that while scales generally demonstrated good structural validity and internal consistency, "only a few have been tested for content validity, reliability, construct validity, and responsiveness" and "none of the scales have been tested for cross-cultural validity and measurement error" (p. 1). Most critically, the majority of studies did not involve target populations in content validation processes, limiting the practical utility and acceptance of these frameworks in educational settings.

This validation gap has profound implications for HEIs seeking to implement AI literacy frameworks. Without proper stakeholder involvement and content validation, even theoretically sound models may fail to achieve practical utility or acceptance among faculty and students. Zhang et al. (2024) emphasise that co-design with teachers and stakeholders is essential not only for curriculum development but also for addressing the practical challenges educators face in integrating AI concepts across diverse academic disciplines.

Building on the outlined challenges, this paper addresses both the implementation and validation gaps. We present the development, implementation, and stakeholder validation of a competency model for AI literacy at a German university of applied sciences for distance learning. The model serves not merely as an assessment instrument but as a strategic tool for curriculum design. It is supported by a comprehensive implementation strategy that features an interactive online platform. The model aims to provide a common language and a reliable framework for the university-wide, systematic promotion of AI competencies across diverse academic disciplines and varying levels of technical expertise. Our contribution is structured as follows: First, we introduce the AICM-HE, a novel multidimensional model. It synthesises the structural findings of Laupichler et al. (2023) with the level-based approach of Teuber et al. (2022) into a flexible framework. Second, we describe an implementation strategy for integrating the model at the institutional level. We describe the architecture and functionality of the supporting online platform, demonstrating how it bridges the gap between theoretical frameworks and practical classroom application. Third, we present the results of a comprehensive stakeholder validation workshop with academic staff. This directly addresses the validation gap identified by Lintner (2024) and ensures the model's practical utility and acceptance.

2 Method

The development and validation of the AICM-HE followed a multiphase, mixed-methods approach within a cyclical, iterative framework designed for continuous improvement. As illustrated in Figure 1, the initial cycle described in this study comprised three distinct phases: (1) the literature-based, interdisciplinary conceptualisation of the model, (2) the technical implementation and institutional integration, and (3) an initial validation and feedback process with key stakeholders to assess the model's comprehensibility, foundation, and utility. The insights gained from this initial validation serve as the foundation for subsequent feedback loops aimed at continuously refining and optimising the model.

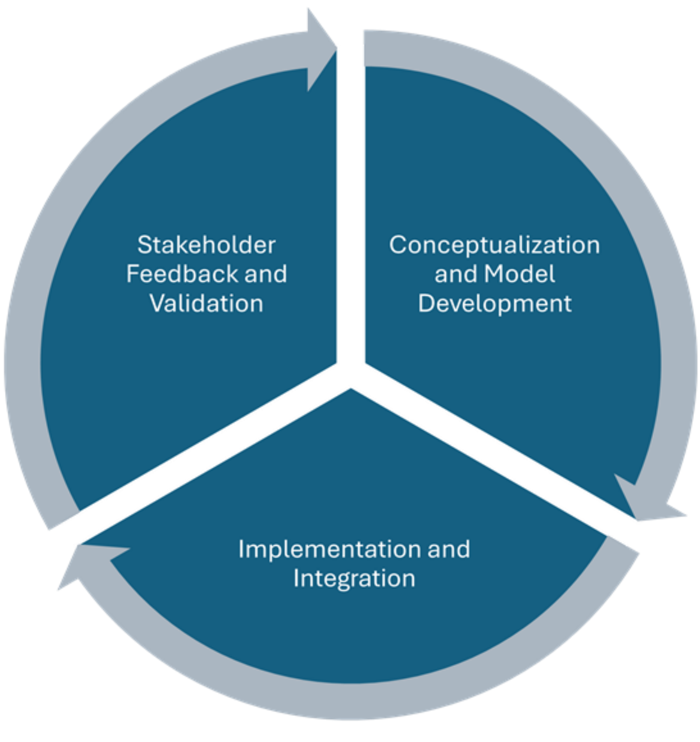

Figure 1. The AI Competency Model for Higher Education (AICM-HE) development and validation process

2.1 Phase 1: Conceptualisation and model development

The competency model was developed by an interdisciplinary project team at the Euro-FH University of Applied Sciences based on an extensive review of existing scientific literature. The goal was to create a model that is (1) relevant to future professional fields, (2) applicable across various disciplines, (3) differentiated to accommodate varying competency levels, and (4) specific enough to be practically implemented.

The model's structure is a synthesis of two highly influential frameworks in AI literacy research. The content dimension of the model, comprising three core sectors, is based on the factor-analytically validated structure proposed by Laupichler et al. (2023). Their "Scale for the assessment of non-experts' AI literacy" (SNAIL) is one of the most rigorously developed instruments to date and is described by Lintner (2024) as a "promising instrument" due to its foundation in an elaborate Delphi study and its multiple revalidation studies. This framework ensures that our model covers the essential pillars of AI literacy: Technical Understanding, Critical Evaluation, and Practical Application.

For the model's vertical differentiation, we adapted the approach of Teuber et al. (2022), who argue that AI competency requirements vary depending on an individual's role and depth of interaction with the technology. Teuber et al. (2022) propose a crucial conceptual framework that recognises the heterogeneous nature of AI literacy needs across different user groups and contexts. Their differentiation into three distinct levels provides a systematic approach to competency development: foundational AI basic competencies for the general population, advanced competencies for professional AI use in occupational contexts, and specialised competencies for AI experts.

This tiered approach acknowledges that not all individuals require the same depth of AI knowledge and skills. While basic AI literacy serves as a foundation for informed participation in an AI-driven society, professional users need more sophisticated competencies to effectively integrate AI tools into their specific work domains. At the highest level, AI experts require specialised technical, methodological and ethical competencies for designing, developing, and managing AI systems. This differentiation enables the tailored design of learning objectives and content, facilitating both broad foundational education and field-specific specialisation.

We transferred this concept to the higher education context by defining three progressive competency levels: Basic AI Competencies, Professional AI Use, and AI Expert Level. This adaptation recognises that HEIs serve diverse student populations with varying career trajectories and AI interaction requirements. The progressive structure allows institutions to provide comprehensive AI literacy for all students while enabling specialised pathways for those pursuing AI-intensive careers, thereby addressing both the democratisation of AI knowledge and the development of specialised expertise.

This two-part synthesis forms the structural basis of the model. However, the specific content populating this matrix was not simply derived from the underlying models. Instead, the individual competency descriptions were defined through a comprehensive additional literature review and iteratively refined in internal expert discussions. This process resulted in a multidimensional framework that systematically maps out 29 distinct, granularly defined competencies.

2.2 Phase 2: Technical implementation and institutional integration

To anchor the competency model in teaching practice, the theoretical framework was translated into a digital support system. The development of the accompanying interactive online platform followed an agile approach, enabling iterative feedback loops with the university's e-learning department. For the technical realisation, an established web-based environment (Articulate Rise 360) was used to ensure low-threshold access for all user groups. This architectural decision deliberately prioritises accessibility, allowing both internal faculty and external teaching staff to use the platform flexibly without the need for complex Learning Management System (LMS) authentication or navigation. Furthermore, a streamlined submission workflow was established to facilitate the continuous integration of new teaching materials by the faculty members. This workflow ensures that the platform remains dynamic and up-to-date.

The platform serves as a central hub for all instructors, designed with both didactic and application-oriented objectives in mind. It provides a comprehensive overview of the AICM-HE model as well as its context and theoretical background. Furthermore, it provides explanations on the distinct content dimensions and competency levels. At the individual competency level, the definitions are explained and enriched with examples describing applications of the respective competency. This virtual platform thus enables educators to use it according to their specific needs.

In line with a best-practice approach, the platform provides educators with a curated collection of AI-related teaching materials already in use at the university, ranging from individual study booklets and courses to complete study units and modules. A workflow has been established through which educators can submit their own materials for inclusion. An expert group evaluates these proposals to ensure their suitability. This fosters a living repository that promotes quality in AI-related teaching and encourages interaction among the faculty members.

To further institutionalise the model, its application is integrated into university-wide guidelines for programme development. Templates for module descriptions were developed including suggested formulations for AI-related learning outcomes that directly reference the competency model. Additionally, educators are continuously informed about the competency model and new developments. Looking ahead, the ongoing development and assessment of the applicability and fit of the model are intended to be systematised and institutionalised.

2.3 Phase 3: Stakeholder feedback and validation

To address the critical validation gap identified in the literature (Lintner, 2024) and to assess the model's practical relevance and acceptance, a feedback and validation workshop was conducted with key stakeholders. The goal was to gather both quantitative and qualitative data from the model's intended users – the academic teaching staff. Since the AICM-HE was intended to address different levels of application and be applicable across various disciplines, it is crucial for the validation of the model to involve stakeholders from different disciplines and with responsibilities across various programme levels.

- **Participants:** A total of 21 key stakeholders participated in the evaluation workshop, which was held as part of a university-wide strategy meeting for educators on 18 September 2025. The sample was intentionally designed to move beyond a purely academic validation by incorporating a wide range of institutional perspectives. While the core of the group consisted of professors with programme and module responsibilities and research associates from all academic departments, their pedagogical feedback was complemented by strategic and operational insights from other key areas. The participation of the President, the Chancellor and the Vice President for Accreditation ensured that the model was evaluated for its strategic fit and its compatibility with university-wide quality assurance and curricular development processes. Furthermore, representatives from the department for digital teaching media provided critical feedback on the model's technical feasibility and integration with the university's digital learning ecosystem. Insights from the department coordinating external teaching staff were vital for assessing how the model could be effectively communicated and implemented among diverse and geographically distributed teaching staff. This multi-stakeholder approach was crucial for validating the model's practical relevance and institutional viability.
- **Procedure:** The workshop procedure was designed to elicit structured and open feedback. Following a 10-minute presentation of the competency model, a 50-minute interactive session was conducted. Participants provided anonymous written feedback on five thematically distinct Metaplan walls. Quantitative data on the model's clarity, perceived foundation, complexity, helpfulness, and usability were collected via dot voting on 5-point and 10-point scales. Qualitative data consisted of written comments addressing the model's utility, suggestions for the online platform, and ideas for measuring implementation success.

- **Data analysis:** The quantitative data were analysed descriptively to calculate means and standard deviations. The qualitative comments were transcribed, thematically clustered, and synthesised by the development team to identify key themes and actionable suggestions for future iterations of the model and its supporting platform.

3 Results and discussion

This section presents the final competency model followed by the results of the stakeholder validation workshop. The findings are then discussed in the context of the current scientific discourse.

3.1 The multidimensional AI competency model

The developed model is a multidimensional framework designed to guide curricular integration (see Figure 2). The three sectors form the content pillars, while the three levels allow for didactic differentiation.

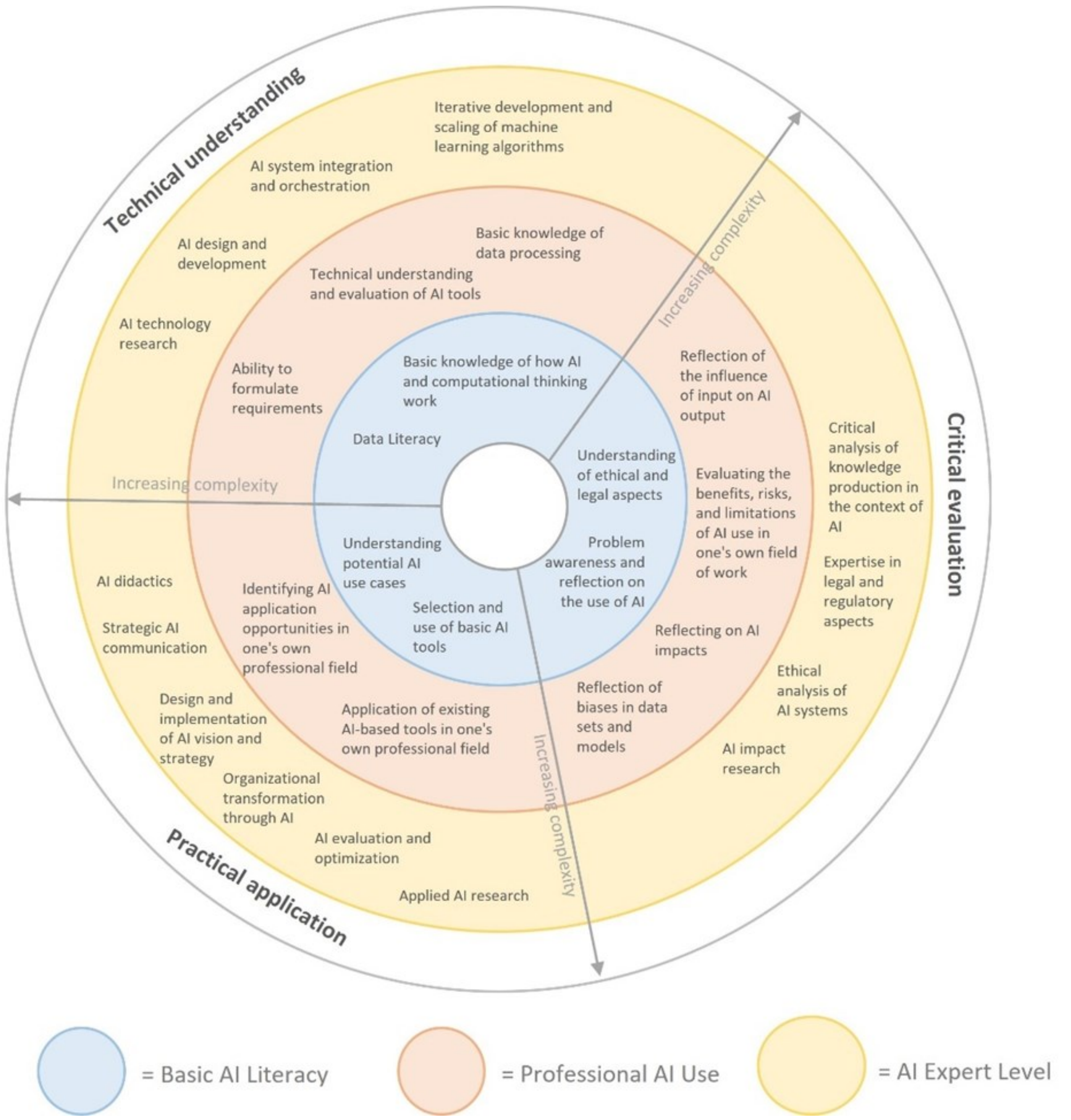

Figure 2. The AI Competency Model for Higher Education (AICM-HE), structured by three sectors and three levels

3.1.1 Sectors (The “What”):

- **Technical Understanding:** Forms the knowledge base for informed engagement with AI. It includes competencies ranging from basic data literacy to understanding the principles of machine learning algorithms.
- **Practical Application:** Bridges the gap between knowledge and action. This sector focuses on the ability to use AI tools productively in academic and professional contexts, from selecting appropriate applications to strategically integrating AI into organisational workflows.
- **Critical Evaluation:** Encompasses the competencies required for a responsible and reflective use of AI. This includes the ability to recognise algorithmic bias, understand ethical and legal implications, and assess the societal impact of AI systems.

3.1.2 Levels (The “How Deep”):

- **Basic AI Competencies:** This foundational level targets all students and aims to foster a general AI literacy necessary for informed societal participation.
- **Professional AI Use:** This intermediate level is for students who will actively use AI tools in their future professional fields. Competencies are more context-specific, focusing on advanced application and domain-specific ethical reflection.
- **AI Expert Level:** This advanced level is designed for students in specialised, AI-related degree programmes. It includes in-depth technical skills required for designing, developing, and managing AI systems.

The intersection of these sectors and levels yields a matrix of 29 specifically defined competencies, each with detailed descriptions and practical examples, which serve as a direct basis for formulating learning outcomes in module descriptions. Table 1 shows examples from different sectors and levels, showcasing each combination of level and sector once.

Table 1. Example competency descriptions of the AICM-HE for different sectors and levels

Level	*Sector*	*Competency*	*Definition*
Basic AI Competencies	Technical Understanding	Basic knowledge of how AI and computational thinking work	Understanding how artificial intelligence makes decisions based on data without in-depth technical knowledge of algorithms or models. This includes the ability to recognise the principles and applications of AI in everyday life. It also includes the ability to approach complex problems in a structured manner by breaking them down into smaller, solvable subproblems in order to develop practical solutions.
Basic AI Competencies	Practical Application	Selection and use of basic AI tools	The ability to identify accessible AI applications for one's own needs, understand their functionality, and apply them securely and purposefully for specific tasks in work, learning, and everyday contexts. This also includes evaluating their suitability for particular use cases.
Basic AI Competencies	Critical Evaluation	Understanding of ethical and legal aspects	Knowledge of data privacy, copyright, fairness, and transparency, as well as the responsibility in handling AI systems. It encompasses the ability to identify potential societal, legal, and ethical challenges and to ensure that AI technologies are used responsibly and in accordance with applicable norms.

Table 1. Example competency descriptions of the AICM-HE for different sectors and levels (continued)

Level	*Sector*	*Competency*	*Definition*
Professional AI Use	Technical Understanding	Technical understanding and evaluation of AI tools	Ability to grasp fundamental concepts, principles, and algorithms of Artificial Intelligence, as well as to evaluate AI tools. This competency includes knowledge of the functionality and application areas of AI, as well as the ability to critically evaluate their utility, quality, and appropriateness in a professional context. It enables individuals to recognise the role of AI technologies and to assess their potential to transform work processes.
Professional AI Use	Practical Application	Application of existing AI-based tools in one's own professional field	The ability to effectively utilise these technologies to improve workflows and optimise outcomes. This competency requires an understanding of the tools' functionalities and their targeted application in professional daily life.
Professional AI Use	Critical Evaluation	Evaluating the benefits, risks, and limitations of AI use in one's own field of work	The ability to critically evaluate the use of AI with regard to its (potential) contribution to achieving professional goals, upholding profession-specific standards and requirements, and its impact on one's own work and the profession as a whole, and to relate these aspects to one another. This includes independent reflection as well as professional discourse.
AI Expert Level	Technical Understanding	AI design and development	The creative and technical process of creating new AI systems. This includes the choice of suitable model architectures, the thoughtful selection of training data, the design of user interfaces for AI-powered applications, as well as the development of robust and interpretable solutions for various industries and tasks.
AI Expert Level	Practical Application	AI evaluation and optimization	Competence in continuously enhancing AI applications in practice. This includes analysing actual performance in deployment, adapting to changing requirements, identifying and addressing weaknesses, and implementing measures to improve efficiency and fairness – with a focus on practical application rather than just theoretical model improvements.
AI Expert Level	Critical Evaluation	Ethical analysis of AI systems	Competence in evaluating AI technologies with regard to ethical principles such as fairness, transparency, and accountability, as well as sustainability. This includes the identification and minimisation of discrimination, the development of ethical guidelines for the use of AI, and raising awareness of moral dilemmas in AI-supported decisions.

3.2 Implementation strategy and online platform

A key result of this project is the concrete implementation strategy, realised through an interactive online platform that supports the theoretical AICM-HE model. This platform serves as a central hub for instructors, bridging the gap between the abstract competency model and practical teaching.

The platform visualises the multidimensional structure of the AICM-HE. As shown in Figure 3 and Figure 4, educators can interactively navigate through the sectors and levels. By selecting a specific competency (e.g., "Data Literacy" within the intersection "Technical Understanding"), users receive the precise definition alongside practical application examples and teaching materials.

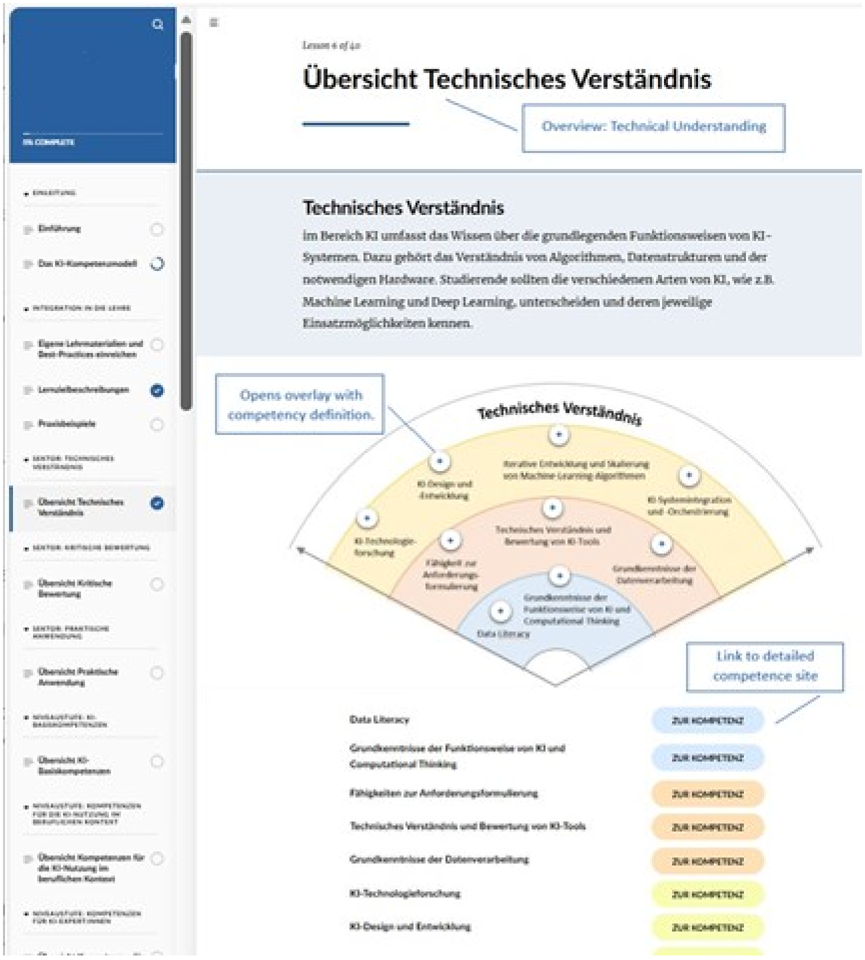

Figure 3. User interface of the AICM-HE online platform: “Technical Understanding” sector (explanations in English in blue font)

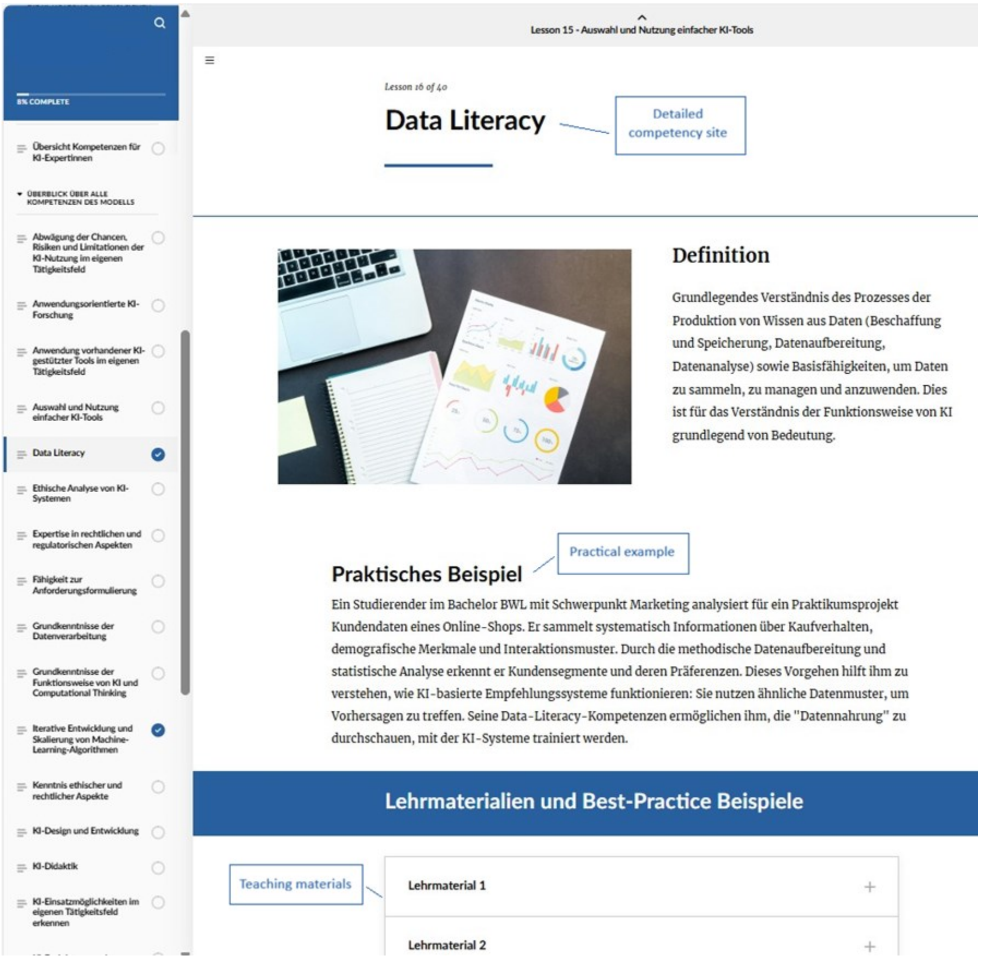

Figure 4. User interface of the AICM-HE online platform: “Data Literacy” competency page (explanations in English in blue font)

The platform provides a curated repository of AI-related teaching materials mapped to the competencies. This feature allows faculty members to find suitable resources – ranging from specific study booklets to complete modules – directly linked to the desired learning outcomes. If faculty members, for example, are looking for materials to develop the “Data Literacy” competency in their degree programme, they open the competency’s detail page and find suggested teaching materials they can use. They check whether the materials fit their degree programme and learning objectives and then either use them directly or adapt them for their purposes.

The implementation strategy extends beyond the digital tool. The model has been successfully integrated into the university's curricular governance. Templates for module descriptions now include preformulated learning outcomes based on the AICM-HE, enabling a standardised yet flexible application across different departments.

3.3 Stakeholder validation results

The workshop provided strong evidence for the model's acceptance and perceived utility among academic staff. The quantitative ratings were consistently positive (see Table 2). Because participants without teaching responsibilities also participated in the workshop, the number of valid answers varied.

Table 2. Quantitative results from the stakeholder workshop

Assessment Question	*Scale*	*Mean (M)*	*Std. Dev. (SD)*	*N*
Clarity of the model	1 (unclear) - 5 (very clear)	4.70	0.46	20
Perceived foundation of the model	1 (unfounded) - 5 (very well-founded)	4.56	0.60	18
Helpfulness for teaching integration	1 (not helpful) - 5 (very helpful)	4.40	0.61	15
Perceived complexity of the model	1 (too simple) - 5 (too complex)	3.05	0.50	20
Perceived ability to use the model	1 (not at all) - 10 (absolutely)	8.26	1.16	19
Helpfulness of the online platform	1 (not helpful) - 10 (very helpful)	9.14	0.83	14

The high mean scores indicate that participants found the model to be clear, well-founded, and a helpful tool for integrating AI competencies into their teaching. The rating for complexity (M = 3.05 on a scale from 1 to 5) suggests the model is perceived as appropriately detailed rather than overly simplistic.

Qualitative feedback further enriched these findings. Key themes that emerged were:

- **Need for practical support:** Participants strongly requested "best practice" examples, concrete application scenarios, and ready-to-use teaching materials to facilitate the model's implementation.
- **Implementation strategy:** There was discussion about whether AI competencies should be taught in a single, compulsory module or distributed across the entire curriculum. A hybrid approach was favoured.
- **Platform functionality:** Suggestions for the supporting online platform included adding AI-driven support (e.g., to help faculty find suitable competencies for their course) and functions for sharing and co-creating materials.
- **Measuring success:** Participants suggested tracking the integration of AI competencies in module descriptions during re-accreditations and conducting surveys with students, faculty, and employers.

3.4 Discussion

The results suggest that the developed model is not only theoretically sound but also practically relevant and well-accepted by its intended users, namely the academic faculty. The positive validation directly addresses the gap of insufficient content validity on the target population that Lintner (2024) identified as a common weakness in AI literacy instruments. By involving faculty in the validation process, we sought to ensure that the model's structure, terminology, and granularity meet the needs of teaching practice.

The model's core strength lies in its multidimensional structure, which synthesises the content breadth of Laupichler et al. (2023) with the application depth of Teuber et al. (2022). This integrated approach prevents a "one-size-fits-all" solution and provides a flexible framework for a heterogeneous student population with varying prior knowledge and career goals, a particularly important feature in the context of distance higher education.

Furthermore, the project goes beyond the mere creation of a model by coupling it with a practical implementation strategy centred on an interactive online platform. This platform, which curates and maps teaching materials to the model's competencies, acts as the crucial link between the abstract framework and concrete classroom activities. The workshop feedback indicated strong demand for such a support structure, highlighting that a model alone is insufficient to guarantee university-wide adoption.

While the stakeholder workshop provided strong evidence for the model's clarity and applicability, the qualitative feedback also pointed to the necessity of domain-specific adaptations. Participants discussed the extent to which specific competencies, such as "Technical Understanding", are relevant across all disciplines (e.g., social sciences versus engineering). This aligns with recent findings by Zhang et al. (2024) regarding the challenges of interdisciplinary AI education. Therefore, while the current model provides a solid university-wide framework, faculty members must still assess which of the listed competencies are relevant for the students in their respective academic disciplines.

While this study provides significant insights into the initial validation of an AI competency model for higher education, some limitations must be considered: The validation was conducted in a single workshop at one institution. While the results are promising, further research is needed to evaluate the model's applicability in different institutional contexts.

Crucially, future evaluations must extend beyond general applicability to assess the specific relevance and utilisation of the individual competencies. It remains to be verified whether educators perceive all listed competencies as meaningful and effectively integrate them into their curricula. Competencies that find little or no application in teaching practice should be critically reviewed and potentially removed to refine the model. Conversely, given the dynamic evolution of AI technologies, the framework must be continuously monitored for completeness to identify and incorporate emerging competencies that may currently be missing.

Moreover, as this study focused on validating the model's structure and utility for educators, the next step will be to empirically assess its effectiveness in fostering AI literacy among students. Future work will therefore concentrate on longitudinal studies to measure actual learning gains and on continuously updating the model to reflect these insights alongside changing labour-market demands.

4 Conclusion

The accelerating integration of Artificial Intelligence into all facets of work and society demands a proactive and structured response from HEIs. This paper has presented a comprehensive AI competency model, the AICM-HE, developed and initially validated to guide the systematic and flexible integration of AI literacy into higher education curricula.

Our model addresses the critical needs identified in current research by offering a novel, multi-dimensional framework. It synthesises established theoretical approaches (Laupichler et al., 2023; Teuber et al., 2022) into a flexible structure comprising three content sectors – Technical Understanding, Practical Application, and Critical Evaluation – and three proficiency levels – Basic AI Competencies, Professional AI Use, and AI Expert Level. This design deliberately avoids a "one-size-fits-all" approach, ensuring adaptability for a heterogeneous student body with diverse prior knowledge and career aspirations, a particularly important feature for distance higher education.

A key contribution of this work lies in its direct response to the validation gap in AI literacy assessment tools (Lintner, 2024). Through a comprehensive stakeholder workshop with academic staff from various disciplines, we obtained positive feedback regarding the model's clarity, perceived scientific foundation, and practical utility for teaching integration. This initial validation is crucial for ensuring the model's relevance and acceptance within the academic community.

Beyond the model's conceptualisation and validation, we have outlined a concrete implementation strategy centred on an interactive online platform. This platform serves as a vital bridge, connecting the abstract competency framework with practical classroom activities by curating and mapping existing teaching materials. The workshop feedback clearly indicated the high demand for such practical support, underscoring that a robust model must be accompanied by effective tools for university-wide adoption.

This study demonstrates that the proactive integration of AI literacy into higher education is a systemic challenge requiring a holistic approach. By analogy with the “Whole Institution Approach” in sustainability education (Kohl et al., 2022; Holst et al., 2024), effectively embedding AI literacy necessitates a strategic engagement across all dimensions of an institution – from curriculum design and pedagogical support to quality assurance and continuous development. The presented competency model and its initial validation represent a crucial, but singular, component of this broader institutional transformation.

Recognising that a competency model is a snapshot in time, particularly in the rapidly evolving field of AI, its continuous development and evaluation are paramount. Future research will focus on expanding the model's empirical validation in diverse institutional contexts. Specifically, it is necessary to assess the domain-specific relevance of individual competencies to determine, for example, how technical depth requirements differ between social sciences and engineering. Furthermore, the mapping of these competencies to specific teaching blocks and degree levels (Bachelor vs. Master) needs to be verified in practice to ensure the model's effectiveness across the entire curriculum. Also, longitudinal studies are needed to assess the effectiveness of our approach to promoting AI competence among students. The interdisciplinary and stakeholder-driven approach employed in this study has proven effective and should guide future iterations. Standardised and validated assessment instruments, developed with continuous input from students and educators, will be essential for measuring learning gains and adapting the model to reflect the dynamic demands of the AI-driven future.

In conclusion, this paper provides a valuable blueprint for HEIs navigating the complexities of AI integration. By combining theoretical rigour with practical validation and a clear implementation strategy, we demonstrate how to transform the general call for AI literacy into a structured, university-wide educational initiative. This ensures that graduates are not merely passive users of AI technologies, but become competent, critical, and responsible contributors to the responsible shaping of an AI-driven future.

Acknowledgement

- **Conflict of interest:** The authors declare that they have no conflicts of interest.
- **Funding:** This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.
- **Research ethics:** This study did not require ethical approval as it involved voluntary feedback from professional staff on an educational model.

References

Allen, L. K., & Kendeou, P. (2024). ED-AI Lit: An Interdisciplinary Framework for AI Literacy in Education. *Policy Insights from the Behavioral and Brain Sciences, 11*(1), 3–10. https://doi.org/10.1177/23727322231220339

Almatrafi, O., Johri, A., & Lee, H. (2024). A systematic review of AI literacy conceptualization, constructs, and implementation and assessment efforts (2019–2023). *Computers and Education Open, 6,* 100173. https://doi.org/10.1016/j.caeo.2024.100173

Bobula, M. (2024). Generative artificial intelligence (AI) in higher education: a comprehensive review of challenges, opportunities, and implications. *Journal of Learning Development in Higher Education, 30*. https://doi.org/10.47408/jldhe.vi30.1137

Cox, A. (2024). Algorithmic Literacy, AI Literacy and Responsible Generative AI Literacy. *Journal of Web Librarianship, 18*(3), 93–110. https://doi.org/10.1080/19322909.2024.2395341

Ehlers, U.-D. (2023). Future Skills Framework. Kompetenzen für die KI-Welt. *managerSeminare, 305*, 70–77.

Holst, J., Grund, J. & Brock, A. (2024). Whole Institution Approach: measurable and highly effective in empowering learners and educators for sustainability. *Sustainability Science, 19*(4), 1359–1376. https://doi.org/10.1007/s11625-024-01506-5

Kohl, K., Hopkins, C., Barth, M., Michelsen, G., Dlouhá, J., Razak, D. A., Bin Sanusi, Z. A. & Toman, I. (2022). A whole-institution approach towards sustainability: a crucial aspect of higher education's individual and collective engagement with the SDGs and beyond. *International Journal of Sustainability in Higher Education, 23*(2), 218–236. https://doi.org/10.1108/IJSHE-10-2020-0398

Laupichler, M. C., Aster, A., Haverkamp, N., & Raupach, T. (2023). Development of the "Scale for the assessment of non-experts' AI literacy" An exploratory factor analysis. *Computers in Human Behavior Reports, 12,* 100338. https://doi.org/10.1016/j.chbr.2023.100338

Lintner, T. (2024). A systematic review of AI literacy scales. *npj science of learning, 9*(50). https://doi.org/10.1038/s41539-024-00264-4

Long, D., & Magerko, B. (2020, 25.–30. April). *What is AI Literacy? Competencies and Design Considerations*. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems, Honolulu, HI, USA (pp. 1–16). https://doi.org/10.1145/3313831.3376727

Mokkink, L. B., Terwee, C. B., Patrick, D. L., Alonso, J., Stratford, P. W., Knol, D. L., Bouter, L. M. & de Vet, H. C. W. (2010). The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: An international Delphi study. *Quality of Life Research, 19*(4), 539–549. https://doi.org/10.1007/s11136-010-9606-8

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence, 2*, 100041. https://doi.org/10.1016/j.caeai.2021.100041

OECD. (2023). *OECD Employment Outlook 2023: Artificial Intelligence and the Labour Market.* OECD Publishing. https://doi.org/10.1787/08785bba-en

Southworth, J., Migliaccio, K., Glover, J., Glover, J. N., Reed, D., McCarty, C., Brendemuhl, J., & Thomas, A. (2023). Developing a model for AI Across the curriculum: Transforming the higher education landscape via innovation in AI literacy. *Computers and Education: Artificial Intelligence, 4*, 100127. https://doi.org/10.1016/j.caeai.2023.100127

Teuber, K., Dindarian, A., & Ekaterina, N. Cv. N. (2022). Künstliche Intelligenz und ihre Anforderungen an den Kompetenzerwerb [Artificial intelligence and its requirements for competence acquisition]. In R. Knackstedt, J. Sander, & J. Kolomitchouk (Hrsg.), Kompetenzmodelle für den Digitalen Wandel. Orientierungshilfen und Anwendungsbeispiele (S. 99–115). Springer. https://doi.org/10.1007/978-3-662-63673-2_5

Zhang, C. X., Rice, R. E., & Wang, L. H. (2024). College students' literacy, ChatGPT activities, educational outcomes, and trust from a digital divide perspective. *New Media & Society, 28*(2), 673-695. https://doi.org/10.1177/14614448241301741