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Creating Artificial Intelligence (AI) Literacy Learning Outcomes for a Quantitative Experimentation Laboratory Course

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Abstract

In the fall of 2025, Mechanical Engineering and Library faculty at California State University, Maritime Academy will develop and pilot Artificial Intelligence (AI) literacy learning outcomes within Mechanical Engineering and Physics courses. The university currently does not have institution-wide AI literacy learning outcomes or systematic support for AI instruction. In preparation, the faculty will collaborate to create an AI literacy framework for courses in which students carry out quantitative experimentation. Instructional and assessment materials designed to teach students about the uses, ethical implications, and limitations of AI throughout the technical paper writing process will be created. Students will practice and evaluate the use of AI throughout the experimentation process, including the literature search, interpretation of past work, data analysis, and manuscript review.

This project seeks to advance AI literacy across diverse educational contexts and to provide an instructional opportunity to establish an equitable understanding about the application of AI, regardless of the level of an individual's prior exposure. The materials will be designed to be applicable in any course where students pair research with quantitative data analysis. This work-in-progress paper presents the theoretical models and existing research that will inform the creation of the AI literacy learning outcomes and framework. This paper uses research on AI literacy and competencies across disciplines within and outside of Engineering and Library Science to determine the current state and efficacy of AI literacy instruction at the undergraduate level. This paper does not explore individual AI tools but rather provides a foundational overview of the competencies and skills students need to engage with current and future AI tools.

Introduction

A pilot study funded by the California Learning Lab's AI Fast Challenge will explore the application of AI in the classroom, specifically in quantitative experiment-based lab courses. In the Fall of 2025, Library and Mechanical Engineering faculty at California State University, Maritime Academy will pilot instructional methods and assessment materials developed for AI Literacy. The courses selected are engineering and physics lab classes at various levels in the curriculum, where students are expected to collect data and write reports. The work includes development of instructional modules to explore the use and limitations of AI with literature reviews, processing of collected measurements, and report generation. A variety of these modules will be trialed in labs such as mechanical engineering senior experimental methods, instrumentation, automation, and electricity and magnetism. The goal of this project will be to create instructional materials for faculty that can in engineering education and more broadly in courses where students work with quantitative data.

A critical goal is to establish the AI literacy learning outcomes and framework from which the instructional modules will be developed. The outcomes will guide the content delivered and the assessment of the efficacy of those materials. This work-in-progress paper presents the theoretical models and existing research that will inform the outcomes and framework. This paper uses research on AI literacy and competencies across disciplines within and outside of Engineering and Library Science to determine the current state and efficacy of AI literacy instruction at the undergraduate level.

AI Landscape

Prior to the recent introduction of generative artificial intelligence, machine learning has been a topic of interest for engineers and scientists for decades. These algorithms were developed to model complex systems based on statistical analysis of large data sets. These methods were often referred to as using "big data." The use of machine learning in engineering has been well-documented throughout the engineering profession. Researchers have examined different approaches and applications of machine learning in modeling the physics at the heart of multiple fields of engineering design, such as fluid mechanics and heat transfer [1], [2]. Le Clainche et al. [3] review the numerous ways that machine learning can be applied to improve aircraft performance. Their detailed discussion of the potential application of machine learning and AI provides numerous examples of how these tools can be applied across multiple disciplines within aerospace engineering, such as fluid mechanics, aerodynamics, aeroacoustics, and combustion.

However, broader interest in machine learning has been sparked by the release of generative AI (GAI) tools in the past few years. Large language models (LLMs) such as ChatGPT or Google Gemini have brought machine learning to the creation of text. Similarly, GAI tools for image creation, such as DALL-E or Adobe Firefly, allow for the creation of images based on text-based queries. In education, this has sparked a great deal of interest among students and faculty in the ethical application of this technology in the classroom. In "AI in Higher Ed: Hype, Harm, or Help," Anthology, an educational technology company, surveyed university student leaders about student use and perception of AI [4]. Over 30% of university leaders believed the use of AI could help "enhance student engagement and interactivity" and "provide personalized learning experiences." Similarly, over 30% of students believed that artificial intelligence could "enhance student engagement and interactivity," provide personalized learning experiences," and be "supportive in helping generate ideas."

The biggest change resulting from the introduction of generative AI tools is not the learning models but the ease of access for new users. Previously, the successful application of machine learning required the development of training data sets and an understanding of statistics and coding. The GAI tools discussed above remove the development component and allow the user to use the tool without an understanding of the inner workings. In education, this barrier removal has meant that students now have new tools available to generate content. The result is that GAI tools are far more accessible to the average person who can create a prompt. In addition to the wide access, the other groundbreaking change is that there is greater interest in making the products from the earlier machine learning research more accessible to the broader user community. For example, there is a great deal of potential new applications that have been unlocked in the engineering industry as a result of these tools. Onatayo et al. [5] review the trends and potential applications for GAI use in architecture, engineering, and construction. The paper explores an expanded role for AI tools that can optimize designs, enhance data retrieval, and automate repetitive tasks. The authors recommend different approaches, key skills, and competencies.

Higher education has been forced to adapt quickly to all these changes to try to take advantage of the new opportunities available while ensuring that student learning still takes place. Over the last two years, a large number of papers have been published on the use of generative AI through engineering education [6]. Many of these papers have focused on potential applications or challenges associated with these tools used in higher education. As GAI tools have become more common, researchers have explored applications in the classroom, such as brainstorming [7], code generation, and personalized tutoring [6]. Others have explored the ethical implications of student use of GAI and how different applications could be considered cheating by allowing the student to bypass the learning and critical thinking development expected of them [8]. Another area of study is the establishment of a framework for instruction on how to use those tools. This includes the development of core competencies for AI literacy prior to the development of instructional materials. Equally as important is the development of assessment tools to help measure the efficacy of the instruction.

As this is a rapidly developing field, multiple researchers are developing competencies, instructional methods, and assessment tools. Until there is a convergence of best practices, this wide array of methods must be reviewed, and tools intentionally selected that best serve the learning outcomes.

AI Literacy

AI Literacy Definitions

Hervieux and Wheatley[9] provide a summary of commonly used definitions of "AI Literacy," (see Table 1). Some are broad, focusing on someone's ability to use and evaluate AI, others focus on specific skills, educational contexts, or use cases. AI is so prevalent already, whether you want to participate or not, it's integrated into web browsers, productivity software, and social media. The most useful definition for this project comes from Long and Magerko [10], "a set of competencies that enables individuals to critically evaluate AI technologies; communication and collaborate effectively with AI; and use AI as a tool online, at home and in the workplace." The authors determined this definition to be the most comprehensive and relevant for our students. This project will focus on exploration of the use various AI tools during the literature search and data analysis portion of their coursework. This definition emphasizes one's ability to critically evaluate AI, while using it effectively and reflect on the implications for current and future use.

Table 1. Definitions of AI Literacy [9]

Author(s)	Definition
Long and Mag-erko (2020)	"A set of competencies that enables individuals to critically evaluate AI technologies; communication and collaborate effectively with AI; and use AI as a tool online, at home, and in the workplace" (p. 2).
Lee et al. (2021)	AI literacy is achieved "through an integration of AI concepts, ethical and societal implications of AI, and the adoption of AI in future jobs" (p. 196).
Mikalef and Gupta (2021)	"An AI capability is the ability of a firm to select, orchestrate, and leverage its AI-specific resources" (p. 2).
Hermann (2022)	"We conceptualize individuals' basic understanding of (a) how and which data are gathered; (b) the way data are combined or compared to draw inferences, create, and disseminate content; (c) the own capacity to decide, act, and object; (d) AI's susceptibility to biases and selectivity; and (e) AI's potential impact in the aggregate" (p. 1270).
Dai et al. (2020)	"Considering the increasing importance of AI, we refer to a student's ability to access and use AI-related knowledge and skills as AI literacy" (p. 3).
Kong et al. (2021)	"AI literacy includes three components: AI concepts, using AI concepts for evaluation, and using AI concepts for understanding the real world through problem solving" (p. 2).

AI Literacy Frameworks and Competencies

To develop student learning outcomes, a review AI literacy frameworks and competencies is needed to shape our project. The academic literature on AI literacy is vast and can be a little overwhelming to sift through. The following is a summary of our findings in scholarly literature.

The most helpful articles in navigating through all the literature were systematic or exploratory reviews, where researchers provide summaries of a multitude of academic articles in AI. We begin by discussing the broader core conceptual frameworks that were identified. In Ng, et al.'s [11] exploratory review of academic literature on AI, they offer four broad aspects of fostering AI literacy, based on Bloom's taxonomy: know and understand, use and apply AI, evaluate and create AI, and AI ethics. In a more recent review of the literature, Amatrafi et al [12] similarly identified five core constructs in framing AI literacy: recognize (be aware), know and understand, use and apply, evaluate, create, and navigate ethically. These frames serve as a starting point for determining what the most relevant AI literacy topics are for us. They also identified some approaches that focus on digital literacy competencies: AI technology knowledge, human actors in AI knowledge, AI steps knowledge, AI usage experience, and AI design experience.

Southworth et al [13] reports on the application of these broader frameworks for the development of *AI Across the Curriculum* program at the University of Florida, where AI is integrated into the curriculum campus-wide. What was most helpful from this implementation are the six student learning outcomes associated with each category (see Table 2).

Table 2: The UF AI Literacy Model [13]

The UF AI Literacy Model: Descriptions for the five AI categories, content, and related student learning outcomes. AI Literacy types based on the model from Ng et al., 2021.

AI Literacy categories	Description	AI content[a]	SLOs
Enabling AI	Support AI through related knowledge and skill development (e.g., programming, statistics) and/or contain a lower total AI content of one of the four Core AI Literacy topics.	10–49%	SLO1. Identify, describe, and explain the components, requirements, and/or characteristics of AI. (Content knowledge and communication) SLO2. Recognize, identify, describe, define and/or explain applications of AI in multiple domains. (Critical thinking and communication)
Know & Understand AI	Know the basic functions of AI and to use AI applications	>50%	SLO1. Identify, describe, and explain the components, requirements, and/or characteristics of AI. (Content knowledge and communication) SLO2. Recognize, identify, describe, define and/or explain applications of AI in multiple domains. (Critical thinking and communication)
Use & Apply AI	Applying AI knowledge, concepts and applications in different scenarios	>50%	SLO3. Select and/or utilize AI tools and techniques appropriate to a specific context and application. (Critical thinking and content knowledge)
Evaluate and Create AI	Higher-order thinking skills (e.g., evaluate, appraise, predict, design) with AI applications	>50%	SLO4. Assess the context-specific value or quality of AI tools and applications. (Critical thinking) SLO5. Conceptualize and/or develop tools, hardware, data, and/or algorithms utilized in AI solutions. (Critical thinking)
AI Ethics	Human-centered considerations (e.g., fairness, accountability, transparency, ethics, safety)	>50%	SLO6. Develop, apply, and/or evaluate contextually appropriate ethical frameworks to use across all aspects of AI. (Critical thinking and content knowledge)

Kong and Zhang [14] propose a three-dimensional framework for AI Literacy: cognitive (AI competencies in using AI to understand the real world), affective (reacting to AI and impact on daily lives), and sociocultural (ethics and societal impact). Similarly, Ng et al[15] also proposes a broader frame addressing affective, behavioral, cognitive, and ethical domains. Chiu et al [16] identified five components of a comprehensive framework: technology, impact, ethics, collaboration, and self-reflection. In the K-12 sector there is the AI 5 Big Ideas that help frame the approach to learning about AI: perception, representation and reasoning, learning, natural interaction and societal impact.

Next, we reviewed recommended or common AI literacy competencies. In Long and Magerko's [10] seminal paper, they identified 17 core competencies users need to interact with and develop AI. Their research is based on a review of academic articles, books, conference papers and grey literature. These competencies focus on how AI works, how to identify and recognize AI, knowing it's strengths and weakness, how to use it effectively, in-depth data literacy skills, creating and developing AI, and lastly the ethics of using AI and potential global impact.

In a more current literature review, Chee et al[17], identified 8 AI competencies categories: AI device and software, data and algorithmic literacy, problem solving, communication and collaboration, AI ethics, career-related competencies, AI content creation, and affective competences. Their research shows the AI literature in higher education emphasizes data analysis, problem-solving, and AI in the workforce. They also categorized their findings by disciplines: technology, engineering, education, communication, medicine, and nursing. For engineering the following competency frames in the literature were identified; data and algorithmic literacy, problem-solving, career-related competencies, and AI content creation.

Faruge et al [18] research goes beyond broad categories and literacy frames and recommends developing an AI competency model with behavioral anchors. Essentially this is taking an AI competency and matching it to a desired behavior that an AI literate user would demonstrate in specific use cases (consumer, creator, etc.).

AI Literacy in Higher Education

Our project proposes to create opportunities for formal learning in laboratory courses where students use quantitative experimentation. We intend to use artifact-based learning, where students master AI skills through using AI [19]. However, it is important to recognize that our students may already be engaging in informal methods of AI literacy such as community-based learning (e.g., informal in-person groups or online discussion forums) and self-directed exercise-based learning (e.g., online courses that are voluntary and supplementary to a student's coursework)[19]. And some students may have already engaged in self-directed artifact-based learning, in which they build and experiment with their own AI projects outside of classroom instruction[19].

Before we develop instruction plans and curricular materials, it is helpful to consider what approaches are being taken in higher education. While this topic is emerging, many of the current examples include courses that focus on English composition using AI tools such ChatGPT [20], [21] and efforts to teach prompt engineering [22], however our project aims to go beyond those specific tools and skills. Following are examples of AI literacy instruction that has been integrated into existing courses.

Fyfe included AI literacy instruction in a course titled "Data and the Human."[23] With support from the University Library in using AI tools, students wrote an essay that integrated content from a text-generating language model with an appendix in which student highlighted the parts of the essay that were written by AI.

Lin et al. included a three-week AI course in a general education course that used lectures and exercises [24]. The lectures were given by faculty from various disciplines to provide students with basic understanding of AI. The final exercise required students to train an AI model and apply it to a motor-controlled car kit.

AI Literacy in Information Literacy Instruction

AI literacy instruction is also emerging as it relates to information literacy instruction and the work that librarians do to support students in the research process. Chaudhuri and Terrones implemented three digital initiatives at Cal State LA [25]. These initiatives include a Canvas module on avoiding plagiarism while using ChatGPT, a Two-Minute Tutorial on using ChatGPT for research, and a research skills webinar that models strategies for using ChatGPT in academic research. These digital initiatives model a way that librarians can scale instruction in many courses and disciplines. Librarians have also included the use of ChatGPT in curriculum-integrated instruction sessions [26], [27]. This approach of addressing AI literacy as it overlaps with information literacy will no doubt be a continuing trend.

Mairn [28] provided a suggested integration of AI competencies into the Framework for Information Literacy, (see Table 3). James and Filgo [29] also offer a brief overview of where ChatGPT specifically fits into the Framework for Information Literacy. Hirvonen [30] provides a general overview on what impact AI will have on information environments, emphasizing the need public knowledge of AI in efforts to work against the negative societal impacts.

In Hervieux and Wheatley's [9] white paper, they interviewed librarians to get a sense of how AI is being integrated into information literacy instructions, but it was only 15 librarians. However, they propose a useful AI framework for information literacy instruction:

1. Knowing the basic principles of AI
2. Understanding the fundamental differences of AI types
3. Experimenting with AI tools
4. Reviewing the outputs and outcomes of AI tools
5. Evaluating the impact of AI on a societal scale
6. Engaging with AI discourse

Table 3: AI Literacy Integration into Information Literacy Standards [28]

STANDARD	UNDERSTANDING	RECOGNITION
Authority Is Constructed and Contextual	Understands the authority of AI-generated content.	Recognizes the role of AI algorithms in shaping information authority and credibility.
Information Creation as a Process	Understands the role of AI in information creation in any format.	Recognizes AI-driven collaboration in content generation.
Information Has Value	Understands the ethical and economic value of AI-generated information.	Recognizes AI's impact on decision-making processes and provides attribution and citation.
Research as Inquiry	Understands how AI tools facilitate research while following ethical guidelines.	Recognizes AI's role in enhancing inquiry and discovery.
Scholarship as Conversation	Understands AI's influence in academic discussions.	Recognizes the importance of engaging with AI-driven scholarly conversations.
Searching as Strategic Exploration	Understands AI-powered search algorithms and recognizes the value of browsing for information.	Recognizes strategic approaches to using AI in information retrieval.

Assessment of AI Literacy Skills

While our project does not intend to develop new methods of assessing AI literacy, we will need to adapt existing instruments to measure the existing AI literacy skills that students have and the effectiveness of the instruction we develop. This section examines current and emerging methods of assessing AI literacy skills and perceptions. Although discussions of AI literacy have taken on a new sense of urgency in many disciplines since the release of Chat GPT in November 2022, in 2021 Ng et al. [31] found 30 studies that evaluated students' AI literacy skills, including knowledge tests, surveys, and student artifacts. In the past two years, an increased interest in the topic has generated the creation and refinement of many new tools. The following are a selection of instruments that have been developed and tested since 2022 that may be useful for our project.

Scales and Questionnaires

Laupichler et al. created and tested a 38-item, self-reported questionnaire for the assessment of non-experts in AI literacy (SNAIL) [32], [33] based on AI literacy courses and books and Long and Magerko's competencies [10]. SNAIL was then used to evaluate an undergraduate AI course [34].

Ng et al. created a 32-item, self-reported questionnaire called AILQ, that measures AI literacy in affective, behavioral, cognitive and ethical domains [35]. Affective questions were meant to measure intrinsic motivation, self-efficacy, career interest and confidence. Behavioral questions examined intention, engagement, and collaboration. Cognitive domain questions focused on thinking skills ranging from lower to higher order levels of Blooms taxonomy. And the ethical domain included questions related to AI ethics and AI for social good.

Wang et al. developed and validated the AI Literacy Scale (AILS) that includes four constructs: awareness, usage, evaluation, and ethics [36]. AILS uses a Likert scale to determine confidence in these four areas. Hobeika et al. adapted the resulting 12-item scale and translated it into Arabic [37]. They tested the scale on university students and found the scale to be valid and reliable.

Carolus et al. created the Meta AI Literacy Scale (MAILS) with the goal of creating a modular instrument that also includes psychological competencies [38]. MAILS uses a Likert scale for 34 items related to applying AI, understanding AI, detecting AI, ethics, creating AI, AI problem solving, learning new AI tools, AI persuasion literacy, and AI emotion regulation. Koch et al. validated the scale but proposed a shorter 10-item scale [39]. Mansoor et al. also adapted MAILS by reducing the Likert scale from 11 points to a 6-point scale [40].

Yaun et al. created a 24-item scale with six sub-constructs at three levels [41]. The scale addresses the individual-level cognitive dimensions of AI features, AI processing, and algorithm influences; the interactive-level behavioral dimension of user efficacy; and the sociocultural-level normative dimensions of ethical consideration and threat appraisal. They acknowledge that the scale was developed and tested in Mandarin and that future efforts should determine if cultural and language-specific nuances were retained in the translation to English.

Knowledge tests

Hornberger et al. developed a multiple-choice AI literacy test [42] based on Long and Magerko's competencies [10]. After testing on university students in Germany, they concluded that the test was reliable and valid. Their questions and answer key were translated into English and provided in an appendix.

Ding et al. developed a similar test, also based on Long and Magerko's competencies [10], but with true/false answers instead of multiple choice [43]. This test was trialed with participants who identified as pre- and in-service teachers in the United States.

Other

Knoth et al. developed a holistic AI literacy assessment matrix that includes domain-specific items for medicine, engineering, and education [44]. This matrix was based on knowledge/cognition, skills/behaviors, and attitudes/values that are adapted for each discipline. They acknowledged that the current landscape of developed instruments relies heavily on Likert-type self-assessments, but that this matrix could be applied to a variety of instrument types.

Assessment for this project

We will probably want to include one of the self-reported scales in combination with either a knowledge test or an examination of student artifacts. The self-reported scales will provide information about students' perceptions and can be used in a pre- and post-environment. These scales may also appeal to instructors who choose to use our OER materials in the future, as they have been previously validated and require little effort to adapt and implement. Therefore, these instruments provide valuable information about where students are in the process of acquiring AI literacy skills to inform instructional needs. However, using a knowledge test or developing rubrics that can be applied to student artifacts or observations of student behavior can provide more objective assessment data that can lead to the further refinement of lesson plans and course curricula.

Discussion

Our research shows similarities between overarching AI literacy frames, with a focus on foundational knowledge, practical application, and ethical considerations. There's also a need for an effective frame, focusing on attitudes and feelings towards AI. A range of core competencies was also identified through our literature search, focusing on digital literacy, technical skills, critical thinking, applied contexts, and communication. There is a clear overlap with these competencies and information literacy standards and frames. The assessment tools reviewed provide a variety of questionnaires and knowledge tests in various formats (Likert, True/False, multiple choice), all of which are grounded in core competencies. This has provided a clear path for choosing appropriate frames, matching competencies to those frames and lastly choosing assessment tools that measure those competencies. However, the literature on AI literacy is developing fast, with new research and suggestions popping up. It has and will continue to be a challenge to keep up to date.

Conclusion

By critically evaluating this existing scholarship, we aim to establish a clear and evidence-based foundation for our instructional design. Our next steps are choosing an AI literacy framework, identifying key competencies, then developing learning outcomes that best fit our courses and students. After that we will align the learning outcomes, assessment tools, and instruction. We will prioritize competencies that align with the cognitive, ethical, and practical demands for undergraduate engineering students. However, we will also review the application of our AI framework in other disciplines in an effort to create instructional materials that can be applied in various educational contexts, focusing on the overlap of AI literacy and information literacy. As we move forward, engaging with faculty across disciplines will be crucial to contextualizing these competencies within the broader educational goals of the laboratory course.

References

[1] S. Cai, Z. Wang, S. Wang, P. Perdikaris, and G. E. Karniadakis, "Physics-Informed Neural Networks for Heat Transfer Problems," *J. Heat Transf.*, vol. 143, no. 060801, Apr. 2021, doi: 10.1115/1.4050542.

[2] J. Willard, X. Jia, S. Xu, M. Steinbach, and V. Kumar, "Integrating Scientific Knowledge with Machine Learning for Engineering and Environmental Systems," *ACM Comput Surv*, vol. 55, no. 4, p. 66:1-66:37, Nov. 2022, doi: 10.1145/3514228.

[3] S. Le Clainche, E. Ferrer, S. Gibson, E. Cross, A. Parente, and R. Vinuesa, "Improving aircraft performance using machine learning: A review," *Aerosp. Sci. Technol.*, vol. 138, p. 108354, Jul. 2023, doi: 10.1016/j.ast.2023.108354.

[4] Anthology, "AI in Higher Ed: Hype, Harm, or Help," 2024. [Online]. Available: https://www.anthology.com/paper/ai-in-higher-ed-hype-harm-or-help

[5] D. Onatayo, A. Onososen, A. O. Oyediran, H. Oyediran, V. Arowoiya, and E. Onatayo, "Generative AI Applications in Architecture, Engineering, and Construction: Trends, Implications for Practice, Education & Imperatives for Upskilling—A Review," *Architecture*, vol. 4, no. 4, Art. no. 4, Dec. 2024, doi: 10.3390/architecture4040046.

[6] S. Strain, A. B. Watson, and M. Hale, “Generative AI as an educational resource,” presented at the 2024 South East Section Meeting, Mar. 2024. Accessed: Jan. 14, 2025. [Online]. Available: https://peer.asee.org/generative-ai-as-an-educational-resource

[7] J. L. Alberd, M. K. Pallikonda, and R. C. Manimaran, “The Future of Learning: Harnessing Generative AI for Enhanced Engineering Technology Education,” presented at the 2024 ASEE Annual Conference & Exposition, Jun. 2024. Accessed: Jan. 14, 2025. [Online]. Available: https://peer.asee.org/the-future-of-learning-harnessing-generative-ai-for-enhanced-engineering-technology-education

[8] R. P. Uhlig, S. Jawad, P. Zamora, and E. Niven, “Ethical Use of Generative AI in Engineering: Assessing Students and Preventing Them from Cheating Themselves,” presented at the 2024 ASEE Annual Conference & Exposition, Jun. 2024. Accessed: Jan. 14, 2025. [Online]. Available: https://peer.asee.org/ethical-use-of-generative-ai-in-engineering-assessing-students-and-preventing-them-from-cheating-themselves

[9] S. Hervieux and A. Wheatley, “Building an AI Literacy Framework: Perspectives from Instruction Librarians and Current Information Literacy Tools,” Choice, White Paper, 2024. [Online]. Available: https://www.choice360.org/wp-content/uploads/2024/08/TaylorFrancis_whitepaper_08.28.24_final.pdf

[10] D. Long and B. Magerko, “What is AI Literacy? Competencies and Design Considerations,” in *Conference on Human Factors in Computing Systems - Proceedings*, Honolulu, HI, 2020.

[11] D. T. K. Ng, J. K. L. Leung, K. W. S. Chu, and M. S. Qiao, “AI Literacy: Definition, Teaching, Evaluation and Ethical Issues,” in *Proceedings of the Association for Information Science and Technology*, 2021, pp. 504–509. Accessed: May 10, 2024. [Online]. Available: https://csu-maritime.primo.exlibrisgroup.com/discovery/fulldisplay/cdi_scopus_primary_2_s2_0_85123909924/01CALS_MAL:01CALS_MAL

[12] O. Almatrafi, A. Johri, and H. Lee, “A systematic review of AI literacy conceptualization, constructs, and implementation and assessment efforts (2019–2023),” *Comput. Educ. Open*, vol. 6, p. 100173, Jun. 2024, doi: 10.1016/j.caeo.2024.100173.

[13] J. Southworth *et al.*, “Developing a model for *AI Across the curriculum*: Transforming the higher education landscape via innovation in AI literacy,” *Comput. Educ. Artif. Intell.*, vol. 4, p. 100127, Jan. 2023, doi: 10.1016/j.caeai.2023.100127.

[14] S. C. Kong and G. Zhang, “A conceptual framework for designing artificial intelligence literacy programmes for educated citizens,” in *Conference proceedings (English paper) of the 25th Global Chinese Conference on Computers in Education (GCCCE 2021)*, Centre for Learning, Teaching and Technology, The Education University of Hong Kong, 2021, pp. 11–15. Accessed: Jan. 13, 2025. [Online]. Available: https://repository.eduhk.hk/en/publications/a-conceptual-framework-for-designing-artificial-intelligence-lite

[15] D. T. K. Ng, J. K. L. Leung, J. Su, R. C. W. Ng, and S. K. W. Chu, “Teachers’ AI digital competencies and twenty-first century skills in the post-pandemic world,” *Educ. Technol. Res. Dev.*, vol. 71, no. 1, pp. 137–161, Feb. 2023, doi: 10.1007/s11423-023-10203-6.

[16] T. K. F. Chiu, Z. Ahmad, M. Ismailov, and I. T. Sanusi, “What are artificial intelligence literacy and competency? A comprehensive framework to support them,” *Comput. Educ. Open*, vol. 6, p. 100171, Jun. 2024, doi: 10.1016/j.caeo.2024.100171.

[17] H. Chee, S. Ahn, and J. Lee, “A Competency Framework for AI Literacy: Variations by Different Learner Groups and an Implied Learning Pathway,” *Br. J. Educ. Technol.*, vol. n/a, no. n/a, doi: 10.1111/bjet.13556.

[18] F. Faruqe, R. Watkins, and L. Medsker, “Competency Model Approach to AI Literacy: Research-based Path from Initial Framework to Model,” *Adv. Artif. Intell. Mach. Learn. Res.*, vol. 2, no. 4, pp. 580–587, 2022, doi: 10.48550/arXiv.2108.05809.

[19] M. Pinski and A. Benlian, “AI Literacy - Towards Measuring Human Competency in Artificial Intelligence,” *Hawaii Int. Conf. Syst. Sci. 2023 HICSS-56*, Jan. 2023, [Online]. Available: https://aisel.aisnet.org/hicss-56/cl/ai_and_future_work/3

[20] J. L. Richmond and K. Nicholls, “Using Generative AI to Promote Psychological, Feedback, and Artificial Intelligence Literacies in Undergraduate Psychology,” *Teach. Psychol.*, p. 1, Oct. 2024, doi: 10.1177/00986283241287203.

[21] T. N. Ngo and D. Hastie, “Artificial Intelligence for Academic Purposes (AIAP): Integrating AI literacy into an EAP module,” *Engl. Specif. Purp.*, vol. 77, pp. 20–38, Jan. 2025, doi: 10.1016/j.esp.2024.09.001.

[22] V. A. Barger, P. R. Chennamaneni, A. J. Dahl, and J. W. Peltier, “‘A How-To-Guide For Bringing Artificial Intelligence Into Life In Your Marketing Curriculum: A Blueprint For Student Learning And Success,’” *Mark. Educ. Rev.*, pp. 1–10, Nov. 2024, doi: 10.1080/10528008.2024.2430259.

[23] P. Fyfe, “How to cheat on your final paper: Assigning AI for student writing,” *AI Soc.*, vol. 38, no. 4, pp. 1395–1405, Aug. 2023, doi: 10.1007/s00146-022-01397-z.

[24] C.-H. Lin, C.-C. Yu, P.-K. Shih, and L. Y. Wu, “STEM based Artificial Intelligence Learning in General Education for Non-Engineering Undergraduate Students,” *Educ. Technol. Soc.*, vol. 24, no. 3, pp. 224–237, 2021.

[25] J. Chaudhuri and L. Terrones, “Reshaping Academic Library Information Literacy Programs in the Advent of ChatGPT and Other Generative AI Technologies,” *Internet Ref. Serv. Q.*, pp. 1–25, Sep. 2024, doi: 10.1080/10875301.2024.2400132.

[26] A. J. Carroll and J. Borycz, “Integrating large language models and generative artificial intelligence tools into information literacy instruction,” *J. Acad. Librariansh.*, vol. 50, no. 4, p. 102899, Jul. 2024, doi: 10.1016/j.acalib.2024.102899.

[27] S. Johnson, E. Owens, H. Menendez, and D. Kim, “Using ChatGPT-generated essays in library instruction,” *J. Acad. Librariansh.*, vol. 50, no. 2, p. N.PAG-N.PAG, Mar. 2024, doi: 10.1016/j.acalib.2024.102863.

[28] C. Mairn, “From the Innovation Lab,” *Comput. Libr.*, vol. 44, no. 7, pp. 14–16, Sep. 2024.

[29] A. B. James and E. H. Filgo, “Where does ChatGPT fit into the Framework for Information Literacy? The possibilities and problems of AI in library instruction,” *Coll. Res. Libr. News*, vol. 84, no. 9, pp. 334–341, Oct. 2023, doi: 10.5860/crln.84.9.334.

[30] N. Hirvonen, “Information literacy after the AI revolution,” *J. Inf. Lit.*, vol. 18, no. 1, Art. no. 1, Jun. 2024, doi: 10.11645/18.1.593.

[31] D. T. K. Ng, J. K. L. Leung, S. K. W. Chu, and M. S. Qiao, “Conceptualizing AI literacy: An exploratory review,” *Comput. Educ. Artif. Intell.*, vol. 2, p. 100041, Jan. 2021, doi: 10.1016/j.caeai.2021.100041.

[32] M. C. Laupichler, A. Aster, and T. Raupach, “Delphi study for the development and preliminary validation of an item set for the assessment of non-experts’ AI literacy,” *Comput. Educ. Artif. Intell.*, vol. 4, p. 100126, Jan. 2023, doi: 10.1016/j.caeai.2023.100126.

[33] M. C. Laupichler, A. Aster, N. Haverkamp, and T. Raupach, “Development of the “Scale for the assessment of non-experts’ AI literacy” – An exploratory factor analysis,” *Comput. Hum. Behav. Rep.*, vol. 12, p. 100338, Dec. 2023, doi: 10.1016/j.chbr.2023.100338.

[34] M. C. Laupichler, A. Aster, J.-O. Perschewski, and J. Schleiss, “Evaluating AI Courses: A Valid and Reliable Instrument for Assessing Artificial-Intelligence Learning through Comparative Self-Assessment,” *Educ. Sci.*, vol. 13, no. 10, Art. no. 10, Oct. 2023, doi: 10.3390/educsci13100978.

[35] D. T. K. Ng, W. Wu, J. K. L. Leung, T. K. F. Chiu, and S. K. W. Chu, “Design and validation of the AI literacy questionnaire: The affective, behavioural, cognitive and ethical approach,” *Br. J. Educ. Technol.*, vol. 55, no. 3, pp. 1082–1104, 2024, doi: 10.1111/bjet.13411.

[36] B. Wang, P.-L. P. Rau, and T. Yuan, “Measuring user competence in using artificial intelligence: validity and reliability of artificial intelligence literacy scale,” *Behav. Inf. Technol.*, vol. 42, no. 9, pp. 1324–1337, Jul. 2023, doi: 10.1080/0144929X.2022.2072768.

[37] E. Hobeika *et al.*, “Multinational validation of the Arabic version of the Artificial Intelligence Literacy Scale (AILS) in university students,” *Cogent Psychol.*, vol. 11, no. 1, pp. 1–12, Jan. 2024, doi: 10.1080/23311908.2024.2395637.

[38] A. Carolus, M. J. Koch, S. Straka, M. E. Latoschik, and C. Wienrich, “MAILS - Meta AI literacy scale: Development and testing of an AI literacy questionnaire based on well-founded competency models and psychological change- and meta-competencies,” *Comput. Hum. Behav. Artif. Hum.*, vol. 1, no. 2, p. 100014, Aug. 2023, doi: 10.1016/j.chbah.2023.100014.

[39] M. J. Koch, A. Carolus, C. Wienrich, and M. E. Latoschik, “Meta AI literacy scale: Further validation and development of a short version,” *Heliyon*, vol. 10, no. 21, p. e39686, Nov. 2024, doi: 10.1016/j.heliyon.2024.e39686.

[40] H. M. H. Mansoor, A. Bawazir, M. A. Alsabri, A. Alharbi, and A. H. Okela, “Artificial intelligence literacy among university students—a comparative transnational survey,” *Front. Commun.*, pp. 1–12, Oct. 2024, doi: 10.3389/fcomm.2024.1478476.

[41] C. W. Yuan, H. S. Tsai, and Y.-T. Chen, “Charting Competence: A Holistic Scale for Measuring Proficiency in Artificial Intelligence Literacy,” *J. Educ. Comput. Res.*, vol. 62, no. 7, pp. 1675–1704, 2024, doi: 10.1177/07356331241261206.

[42] M. Hornberger, A. Bewersdorff, and C. Nerdel, “What do university students know about Artificial Intelligence? Development and validation of an AI literacy test,” *Comput. Educ. Artif. Intell.*, vol. 5, p. 100165, Jan. 2023, doi: 10.1016/j.caeai.2023.100165.

[43] L. Ding, S. Kim, and R. A. Allday, “Development of an AI literacy assessment for non-technical individuals: What do teachers know?,” *Contemp. Educ. Technol.*, vol. 16, no. 3, p. ep512, Jul. 2024, doi: 10.30935/cedtech/14619.

[44] N. Knoth *et al.*, “Developing a holistic AI literacy assessment matrix – Bridging generic, domain-specific, and ethical competencies,” *Comput. Educ. Open*, vol. 6, p. 100177, Jun. 2024, doi: 10.1016/j.caeo.2024.100177.