Developing a conceptual framework for Artificial Intelligence (AI) literacy in higher education

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Abstract

This paper proposes a conceptual framework for integrating Artificial Intelligence (AI) into the curriculum. It builds on previous conceptual papers, which provided initial suggestions on integrating AI into teaching. The approach to developing the conceptual framework includes drawing on existing frameworks, AI literature, and case studies from the Queen Mary University of London President and Principal, an AI literacy-funded project. The opinion piece aims to advance our thinking on creating a teaching and learning toolkit to support educators in integrating AI into their teaching, enhancing students' AI literacy and skills. This paper has two main objectives: first, it develops an AI literacy conceptual framework to support educators in integrating AI into their teaching, and second, it provides suggestions on how to engage with it.

Keywords: AI literacy conceptual framework; AI literacy; AI learning activities; higher education.

Introduction

The urgency for equipping students with AI skills is not just a matter of professional development but a necessity for their employability and AI-literate functioning global citizens in an AI-enabled economy. This urgency is driven by stakeholders such as employers, educators, students, and Higher Education Institutions (Zhou and Schofield, 2024). For example, many governments, including the UK, the USA, and China, have recognised the importance of AI literacy in higher education (Laupichler et al., 2022).

Microsoft highlights the importance of having AI literacy and asserts that most company executives will not hire anyone without AI skills (Okemwa, 2024). Deloitte is driving a push for investment in AI literacy programmes and emphasises the need for organisations to invest in AI literacy programmes, ensuring that all employees, irrespective of their role, have a foundational understanding of AI's capabilities and implications (Deloitte, 2023). Furthermore, the World Economic Forum projects that 50% of employees will require reskilling by 2025, focusing on AI capabilities (World Economic Forum, 2024). Although McKinsey predicts a 20% increase in productivity using basic AI tools (McKinsey, 2023), 77% of workers say using AI decreased productivity and added to their workload (Segal, 2024). Further, AI chipmaker stocks slumped in the last few months, demonstrating that the hype might not be what was expected (da Silva, 2024); regardless of these diverse perspectives, AI literacy is an essential employability skill.

Despite the push from employers, there is still apprehension about using AI in education. Educators' hesitation to adopt AI in education is justified by concerns over plagiarism, privacy issues, ethical considerations, and issues of privacy (Fui-Hoon Nah et al., 2023; Lodge et al., 2023; O'Dea and O'Dea, 2023; Rasul et al., 2023). This is followed by a gap in technology pedagogy knowledge (Celik, 2023) due to a lack of guidance and training. Therefore, a framework is necessary to assist educators in integrating AI into their teaching. Although AI literacy frameworks exist, for example, Sabzalieva and Valentini's (2023) AI implementation in teaching framework, Ng et al.'s (2023) and Southworth et al.'s (2023) AI literacy framework, they do not go further or provide clear guidance to educators on the teaching and learning activities and GenAI tools that they can adopt. Our proposed AI in teaching and learning framework (see Table 1) seeks to close these gaps and provide comprehensive guidance for educators to adopt GenAI in their teaching.

AI literacy

Building on the necessity of equipping students with generative AI skills, AI literacy becomes a crucial competency for students and educators. AI literacy is not just about learning to use AI tools but also involves critical application and understanding of the ethical, societal, and practical implications of using the tools. AI literacy encompasses several key competencies, which include knowing how to use AI technologies, understanding underlying concepts, applying them to solve problems, thinking critically,

and considering ethical limitations and social implications (Kong et al., 2021). Furthermore, it encompasses ethical understanding and social responsibility, recognising the ethical implications of AI, including privacy, bias, and societal impact, and using AI ethically (European Commission, 2022). Laupichler et al. (2022, p.1) define AI literacy as 'the ability to understand, use, monitor, and critically reflect on AI applications without necessarily being able to develop AI models themselves'. This paper draws on the above definition.

AI literacy includes four essential dimensions: 1) 'Know and understand AI'; 2) 'Use and apply AI'; 3) 'Evaluate and create AI'; and 4) 'AI ethics' (Ng et al., 2023). According to Ng et al. (2021), 'know and understand AI' relates to the bottom two levels of Bloom's taxonomy, which are 'know' and 'understand', and involves a basic understanding of AI and how it functions; 'use and apply AI' relates to the apply level of Bloom's taxonomy and involves the ability to use AI tools to accomplish tasks and apply them in different scenarios; 'evaluate and create AI' relates to the top three levels to analyse, evaluate, and create and involves higher-order thinking skills to evaluate, appraise or design with AI tools (Ng et al., 2021). AI ethics involves making informed, responsible decisions about the appropriate use of AI in different contexts (Ng et al., 2023).

Developing AI for teaching and learning conceptual framework

Our AI in teaching and learning framework is mapped on four dimensions of AI literacy mentioned above. Each dimension has specific learning objectives, teaching and learning activities, and GenAI tools tailored to the respective learning activities. For example, at the dimension of 'know and understand AI', the objective might be to introduce learners to the fundamental concepts of AI, ensuring they understand the basic uses of AI in learning. For the 'use and apply AI' level, the objective shifts towards using AI for problem-solving. At the advanced level, the objective focuses on developing higher-order thinking skills, such as critical thinking.

Finally, the framework provides ideas of possible GenAI tools that module organisers could incorporate into their teaching. The framework is designed to facilitate progressive learning. According to Ng et al. (2021), the levels of capability are arranged in a progressive order, adopting Bloom's taxonomy (Bloom et al., 1956). Building on this concept, our framework provides detailed guidelines for educators, including a checklist to

assist them in choosing learning activities and AI tools for incorporating AI into their teaching methods.

Table 1. AI in teaching and learning framework.

Learning objective	Teaching and learning activities	GenAI tools
AI literacy: Know and understand AI		
Know and understand the basic functions of AI tools to support learning.	☐ **Understand**: students are exposed to the definition of AI, its scope, concepts, techniques, and basic structured knowledge of AI algorithms. ☐ **Explore**: students are instructed to formulate queries using Generative AI (GenAI) tools. Subsequently, they should develop their understanding of using AI tools for basic exploration and explore alternative responses to deepen their comprehension. ☐ **Take notes**: students are encouraged to employ AI-based note-taking tools to accurately record and later reflect on the transcribed notes. This activity aims to encourage reflection on the learned material and for revision. ☐ **Brainstorming**: students are encouraged to use Generative AI tools such as ChatGPT and Claude to brainstorm ideas such as the structure of writing assignments and initial idea generation for research projects. ☐ **Mind mapping**: students can use tools such as Miro to facilitate the mind mapping of ideas and organise themes. This process is designed to enhance using AI tools for visual learning, allowing students to better structure their thoughts and ideas. ☐ **Writing**: students are to engage in assisted writing exercises, utilising AI-driven tools to ensure grammatical accuracy and enhance the clarity of their written communications. This practice is intended to improve their written proficiency and attention to detail in language usage.	ChatGPT, Poe, Claude, Notion AI, Gemini, Llama 2, Otter, Bing, Miro, Grammarly, Quillbot Monica, Midjourney, ChatPDF, Canva, Gamma.

	☐ **Summary**: in a classroom setting, instruct students to use AI tools to engage with reading materials and summarise articles and case studies. This approach not only improves comprehension but also allows for a more interactive and engaging learning environment. ☐ **Collaborate**: students can be encouraged to use collaborative tools such as Miro and Lucidchart to work together in groups, enabling them to effectively share ideas, map out project plans, and visualise concepts in a shared, interactive environment. ☐ **Presentation**: students are prompted to use AI-based tools, such as Gamma or Canva, to craft their presentations or construct professional bios or profiles. This activity encourages proficiency in digital literacy, enhancing their presentation skills and their ability to professionally represent themselves. ☐ **Generate images**: students are encouraged to use Generative AI to produce images relevant to their tasks. This task is aimed at developing creativity and understanding of how AI can be leveraged for artistic and practical outputs.	
AI literacy:	**Use and Apply AI**	
Applying AI knowledge, concepts and applications to support learning.	☐ **Apply AI for paper research**: encourage students to utilise AI tools such as Connected Papers or Consensus to efficiently organise project sources, conduct literature reviews, or gather research for assignments. This facilitates a more streamlined research process, allowing for a comprehensive understanding of the subject matter. ☐ **Apply AI for systematic literature review:** prompt students to employ Generative AI tools like Elicit, Covidence and Rayyan to perform systematic literature reviews. These tools aid in synthesising existing research findings, enhancing academic rigour and breadth of scholarship. ☐ **Apply AI for information search**: Generative AI, such as ChatGPT, could be used to search for information. Urge students to integrate AI tools in their search for academic resources, complementing traditional research methodologies such as	ChatGPT, Poe, Claude, Monica, Perplexity, Gemini, Llama 2, Midjourney, Elicit, Connected papers, Consensus, Miro, Covidence, Rayyan, Canvas.

	querying academic databases like EBSCO. Class activity should include reflections on and critical evaluation of the generated information. ☐ **Apply AI in problem-solving**: implement exercises where students utilise AI tools to address and solve specific problems. This practice encourages analytical thinking and the application of technology in developing practical solutions. ☐ **Apply AI for data visualisation**: conduct exercises that require students to use AI tools to analyse raw data and identify trends, such as performance metrics or sales data. This enhances students' ability to interpret data visually and make data-driven decisions. ☐ **Apply AI for data analysis**: motivate students to use AI tools for data analysis tasks. This includes training on how to handle, process, and draw conclusions from large datasets, fostering skills that are essential in data-driven industries. ☐ **Apply AI tools to create, sketch, or design**: demonstrate and encourage students to use AI tools to create multimedia content, such as videos or digital sketches. This activity promotes creativity and familiarity with cutting-edge tools that are increasingly relevant in digital communication and media.	
AI literacy:	**Evaluate and create with AI**	
Evaluating AI-generated content enabling higher-order thinking skills develop-ment.	☐ **Evaluating data types and quality:** students should assess various data types, distinguish between structured and unstructured data, and evaluate data quality based on completeness, accuracy, and consistency. ☐ **Dataset evaluation:** students are expected to choose an AI tool to evaluate a specific dataset, then analyse and discuss the strengths and weaknesses of both the data and the tool in a presentation format. ☐ **Practical data manipulation and analysis:** utilise AI software for hands-on exercises where students manipulate, evaluate, and	ChatGPT, Claude, Gemini, Llama 2, Monica, HyperWrite, Co-pilot, APPRAISE-AI.

	analyse datasets to understand the practical applications and limitations of these tools and create critical analysis reports. ☐ **Complex information evaluation:** present students with case studies that require them to evaluate decisions and outcomes and create alternative solutions, fostering critical thinking about complex information. ☐ **AI in evaluating societal challenges:** encourage students to maintain reflective journals that record their observations and experiences with societal issues. Use AI tools to analyse these journals for prevalent themes and sentiments. Further, it presents case studies on societal challenges, urging students to use AI to delve deeper into these issues and supplement their findings with academic, peer-reviewed sources and create solutions to address societal challenges.	
AI literacy:	**AI Ethics**	
Comprehend-ing the moral and ethical conse-quences of AI and making informed decisions regarding its use in various contexts.	☐ **Implement clear AI assessment policies**: clearly define and communicate the policies concerning the use of AI in assessments. Students should know when and how AI can be utilised for ideas generation and academic writing tasks. It is important to establish and enforce rules regarding the verification of AI-generated content for authenticity and to guide students on properly acknowledging GenAI assistance in their work. ☐ **Explain the ethical implications of GenAI**: initiate discussions with students about the specific policies governing GenAI use in educational settings. Ensure that students comprehend the necessity of using GenAI responsibly, especially in learning environments and assessments. This includes teaching students how to justify employing AI tools in their studies and how to confirm the credibility of AI-derived data and analysis. ☐ **Discuss AI hallucination**: make students aware of AI's limitations, such as its inability to access some peer-reviewed academic resources behind paywalls and its potential to generate	All AI tools

| | non-existent references. This understanding is crucial for fostering a critical perspective on GenAI's sources and outputs.

☐ **Apply and adopt GenAI ethically**: educators ensure that the students are aware of the capability and limitations of AI. Ensure that students are able to address the ethical issues surrounding the reliability of the outputs and quality check the quality of the output.

☐ **Co-creating AI ethics**: identify the ethical issues and biases and co-create appropriate responses, allowing students to participate in creating policies, guidelines, and frameworks that ensure the ethical and responsible usage of AI. | |

Suggestions for using the conceptual framework

The approach we adopted for using this conceptual framework is a bottom-up approach rather than a top-down approach for several compelling reasons. By bottom-up approach, we mean module organisers are at the forefront of driving AI adoption and integration. A top-down strategy, driven by the programme director or education committee, can often be bureaucratic, imposing AI adoption on educators regardless of their readiness, which can lead to resistance, particularly at a time when there is a critical need for staff to enhance their skills to prepare students for the workforce. Further, the top-down approach can often involve a lengthy approval process, requiring more time to implement changes. On the other hand, a bottom-up approach places power with the module organisers and tutors, who champion AI in their teaching and to their peers. The strategy behind this approach is to build support from educators who already integrated or are planning to integrate AI into their teaching practices. This is particularly relevant when integrating disruptive technologies like AI into educational settings.

The programme director can also use this framework to ensure that students' AI skills are fully developed. The programme director does this by reviewing the whole programme with the framework and looking for gaps where students' AI skills are not present. They could then work with module organisers to integrate AI to close the gap. If integrating AI into curricular activities is challenging, the programme director should provide extracurricular activities, including workshops, clubs, or special project groups, to close the gap. The

programme director should aim to close the gap and ensure consistent development of AI skills among students during their learning journey. The programme director should also ensure that all the dimensions are covered and that by the time the students finish their studies, they are competent in all the AI dimensions.

The AI in teaching and learning framework is intended as a flexible guide, allowing educators to adapt its contents to the unique requirements of different disciplines. The activities and the dimensions of competence outlined in the framework can be mixed and matched according to the specific needs of each discipline. The module organiser may draw on the framework based on the dimension(s) they want to integrate into their module. For instance, in the MSc Management Contemporary Live Project module, GenAI was integrated into the curriculum to enhance students' AI literacy, specifically in the dimensions of 'use and apply' and 'evaluate and create' with AI, as outlined by Schofield and Zhou (2024). The students were asked to apply generative AI in creating professional profiles, data analysis, and literature search.

Conclusion

In conclusion, the conceptual framework provides a structured approach to integrating AI into the curriculum. The framework offers guidance to ensure a progressive development of AI skills within the curriculum by aligning specific learning objectives, teaching activities, assessment methods, and digital resources. This approach equips students with the fundamental knowledge and practical skills required to engage with AI, preparing them for an AI-driven economy.

Limitations and future direction

The aim of this conceptual paper is to provide a starting framework for educators to use to ensure that students are equipped with AI skills and that it is done progressively so that students, throughout their study, progressively develop AI skills for employability. However, there are limitations to this paper. First, though the paper draws on some data from our AI literacy project, the framework is based on conceptual papers and existing frameworks without empirical studies validating its effectiveness. There is a need for

empirical research to assess the practical impact and outcomes of the proposed AI integration in higher education curricula. Second, while the framework aims to be interdisciplinary, AI's unique requirements and applications in different fields (e.g. humanities vs. engineering) may not be fully addressed. Future research should focus on the framework's adaptability to rapidly evolving GenAI technologies and practices in different subjects. The framework does not address how teaching and learning activities contribute to lifelong learning and student independence. Future research could explore how teaching and learning activities could develop students' lifelong skills and self-directed learning related to AI. Potential institutional and resource constraints that could affect the implementation of the framework are not discussed, which could pose significant challenges in practical settings. Regular updates and revisions, informed by feedback from students, employers, and module organisers, will help maintain the relevance and effectiveness of the AI curriculum while keeping pace with the rapid advancements in the field.

Acknowledgements

References

Bloom, B. S., Engelhart, E. J., Hill, W. H. and Krathwohl, D. R. (1956) The classification of educational goals, handbook I: Cognitive domain. *New York: David McKay*.

Celik, I. (2023) 'Towards Intelligent-TPACK: an empirical study on teachers' professional knowledge to ethically integrate artificial intelligence (AI)-based tools into education', *Computers in Human Behavior*, 138, p.107468. Available at: https://doi.org/10.1016/j.chb.2022.107468

da Silva, J. (2024) 'Shares drop in US and Asia as AI stocks slide', *BBC*, 25 July. Available at: https://www.bbc.co.uk/news/articles/ck5gp185n6ro (Accessed: 10 Sep 2024).

Deloitte (2023) *Generative AI and the future of work the potential? Boundless*. Available at: https://www2.deloitte.com/content/dam/Deloitte/de/Documents/human-capital/Deloitte_GenAI-Future-of-Work.pdf (Accessed: 09 May 2024).

The European Commission (2022) *Ethical guidelines on the use of artificial intelligence (AI) and data in teaching and learning for educators*. Available at: https://data.europa.eu/doi/10.2766/153756 (Accessed: 06 Sep 2024).

Fui-Hoon Nah, F., Zheng, R., Cai, J., Siau, K. and Chen, L. (2023) 'Generative AI and ChatGPT: applications, challenges, and AI-human collaboration', *Journal of Information Technology Case and Application Research*, 25(3), 277-304. Available at: https://doi.org/10.1080/15228053.2023.2233814

Kong, S. C., Cheung, M. Y. W. and Tsang, O. (2024) 'Developing an artificial intelligence literacy framework: evaluation of a literacy course for senior secondary students using a project-based learning approach', *Computers and Education: Artificial Intelligence*, 6, 100214. Available at: https://doi.org/10.1016/j.caeai.2024.100214

Laupichler, M. C., Aster, A., Schirch, J. and Raupach, T. (2022) 'Artificial intelligence literacy in higher and adult education: a scoping literature review', *Computers and Education: Artificial Intelligence*, 3, 100101. Available at: https://doi.org/10.1016/j.caeai.2022.100101

Lodge, J. M., de Barba, P. and Broadbent, J. (2023) 'Learning with generative artificial intelligence within a network of co-regulation', *Journal of University Teaching & Learning Practice*, 20(7). Available at: https://doi.org/10.53761/1.20.7.02

McKinsey (2023). *The economic potential of generative AI: The next productivity frontier*. Available at: https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier (Accessed: 09 May 2024).

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W. and Qiao, M. S. (2021) 'Conceptualising AI literacy: an exploratory review', *Computers and Education: Artificial Intelligence*, 2, p.100041. Available at: https://doi.org/10.1016/j.caeai.2021.100041

Ng, D. T. K., Leung, J. K. L., Su, J., Ng, R. C. W. and Chu, S. K. W. (2023) 'Teachers' AI digital competencies and twenty-first century skills in the post-pandemic world', *Education Tech Research Dev*, 71, pp.137-161. Available at: https://doi.org/10.1007/s11423-023-10203-6

O'Dea, X. C. and O'Dea, M. (2023) 'Is artificial intelligence really the next big thing in learning and teaching in higher education? A conceptual paper,' *Journal of University Teaching and Learning Practice*, 20(5). Available at: https://ro.uow.edu.au/jutlp/vol20/iss5/

Okemwa, K. (2024) 'Microsoft says most company execs won't hire anyone without an AI aptitude, prompting "a 142x increase in LinkedIn members adding AI skills like Copilot and ChatGPT to their profiles', *Yahoo Tech*, May 8. Available at: https://www.yahoo.com/tech/microsoft-says-most-company-execs-120001709.html?guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAE28e-Q2CCeEuEe-RILKjNcQ7NYZjxxGR-1BT1wiRPZ6F5vZ0L16s9JA-QhVLpj3dWDcgoi3ZhwJkPhOAakRz-CwIf97DIbZNaGZCYIgAeAai5YUd0tVz3oOVATJRUnu4Fd9gcolEo4c6RmYrEfOcqqzXf8MSs_o2B95Ted4nh3n (Accessed: 10 May 2024).

Rasul, T., Nair, S., Kalendra, D., Robin, M., de Oliveira Santini, F., Ladeira, W. J., Sun, M., Day, I., et al. (2023) 'The role of ChatGPT in higher education: benefits, challenges, and future research directions', *Journal of Applied Learning and Teaching*, 6(1). Available at: 787-Article Text-3375-1-10-20230510

Sabzalieva, E. and Valentini, A. (2023) 'ChatGPT and artificial intelligence in higher education: quick start guide', *UNESCO's International Institute for Educational Planning*. Available at: https://etico.iiep.unesco.org/en/chatgpt-and-artificial-intelligence-higher-education-quick-start-guide (Accessed: 05 Jun 2024).

Segal, E. (2024) 'AI adds to the workload and stress of employees, report says', *Forbes*. Available at: https://www.forbes.com/sites/edwardsegal/2024/07/23/ai-adds-to-the-workload-and-stress-of-employees-report-says/#:~:text=The%20survey%20for%20the%20Upwork,or%20moderating%20AI%2Dgenerated%20content (Accessed: 23 Sep 2024).

Schofield, L. and Zhou, X. (2024) 'Practical examples of integrating generative AI into the learning activities of the capstone project module', *BERA blog*. Available at: https://www.bera.ac.uk/blog/practical-examples-of-integrating-generative-ai-into-the-learning-activities-of-the-capstone-project-module. (Accessed: 23 Sep 2024).

Southworth, J., Migliaccio, K., Glover, J., Glover, J., Reed, D., McCarty, C., Brendemuhl, J. and 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, p.100127. Available at: https://doi.org/10.1016/j.caeai.2023.100127

World Economic Forum (2024) *Reskilling revolution: preparing 1 billion people for tomorrow's economy*. Available at: https://www.weforum.org/impact/reskilling-revolution-reaching-600-million-people-by-2030/ (Accessed: 09 May 2024).

Zhou, X. and Schofield, L. (2024) 'Using social learning theories to explore the role of generative Artificial Intelligence (AI) in collaborative learning', *Journal of Learning Development in Higher Education*. Available at: https://doi.org/10.47408/jldhe.vi30.1031

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