

AI and Data Science Literacy Framework for Educators

Nurul Amelina NASHARUDDIN^{ab*}, Nurfadhlin MOHD SHAREF^c & Mohd Khaizer OMAR^d

^a*Department of Multimedia, Universiti Putra Malaysia, Malaysia*

^b*Faculty of Mathematics and Computer Science, University of Münster, Germany*

^c*Department of Computer Science, Universiti Putra Malaysia, Malaysia*

^d*Centre for Academic Development and Leadership Excellence, Universiti Putra Malaysia, Malaysia*

*nurulamelina@upm.edu.my

Abstract: Advancements in artificial intelligence (AI) technology have led to increased interest in AI in education, with educators arguing for AI literacy to effectively incorporate AI into teaching methods. Proficiency in data science (DS) is crucial due to the vast amount of available educational data. AI and DS literacy focusses on conceptual, pedagogical, and ethical aspects of six knowledge areas: AI basics, data science literacy and AI integration, ethical AI and responsible data use, AI focused on people, AI pedagogy, and AI-based personalised learning. Technical skills, such as programming, are also important, but advanced technical skills such as programming skills are not emphasised. A pilot framework for AI and DS literacy is suggested, aiming to provide educators with the necessary knowledge and skills to prepare students for the digital age.

Keywords: AI literacy, data science literacy, educators, higher education institutions

1. Introduction

Artificial intelligence-based (AI) learning analytics offer valuable insights into student engagement, performance, and learning preferences. Utilising data-driven approaches can significantly enhance student success rates and overall academic outcomes in educational institutions. Nevertheless, optimising the potential of learning analytics for operational purposes requires specific pedagogical strategies (Mohd Sharef et al., 2021). Educators need the skills to comprehend and interpret data effectively, drawing meaningful insights to guide their instructional strategies. Proficiency in AI and data science (DS) skills is essential for educators to develop a deep understanding of how to leverage digital technologies and data tools and effectively utilise digital data for pedagogical purposes. Thus, a comprehensive framework for HEIs educators can bridge the gap in knowledge and skills required to implement AI technologies effectively in education.

2. Literature Review

Many educators lack analytics proficiency and knowledge of personalised interventions, making it difficult to effectively use data in education (Liu et al., 2023; Ndukwe & Daniel, 2020). Learning management systems' extensive information and lack of guidance also make it difficult for educators to use data effectively (Zheng et al., 2021). Despite the need for specialised education and training programs, current efforts often overlook the unique needs of various stakeholders, resulting in educators lacking the necessary skills and awareness to effectively utilise AI technologies.

AI literacy refers to the skills needed to interact and critically evaluate AI technologies, fostering increased understanding of AI (Long & Magerko, 2020) while DS literacy is the ability to use data effectively for decision-making (Mandinach & Gummer, 2013). Despite extensive

literature, most focus is on students' literacy. Challenges faced by educators in using AI-driven technologies include technological difficulties and communication issues (Ng et al., 2021). Existing frameworks often overlook DS's main purpose of transforming data into valuable insights (Overton & Kleinschmit, 2021). To address these, developing technical skills, working collaboratively, and enhancing AI and DS literacy competencies like are suggested. This study examines AI and DS literacy in education literature, proposing a unified framework to guide educators in developing essential skills, bridging the gap between theoretical knowledge and practical application in educational settings.

3. Method and Materials

This study evaluates six AI and DS literacy frameworks from previous research, including the TUCAPA model (Laupichler et. al., 2023), ED-AI Lit (Allen & Kendeou, 2024), Core Competencies and Contents for Data Literacy Instruction (Prado & Marzal, 2013), adapted data literacy skills from a Data Science course (Dichev & Dicheva, 2017), and the Data Science Literacy Framework (DSLRF) for teaching research methodology (Overton & Kleinschmit, 2022). The frameworks were picked because they have been important in research on AI and DS in various fields, including education. They will be adapted to guide educators in developing essential AI and DS skills, ensuring a comprehensive approach to AI and DS education. The literature was selected through a narrative review methodology inspired by Stolpe and Hallstrom (2024), and qualitative content analysis was used to categorise and prepare, organise, and report these frameworks.

4. Unified AI and Data Science Literacy Framework: Putting the Skills Together

The key aspects of competencies from the six frameworks reviewed serve as a starting point for developing a comprehensive approach to AI and DS literacy in educational settings. The proposed framework focusses on conceptual, contextual, pedagogical, and ethical aspects of AI integration, aiming to empower educators to make informed decisions and enhance learning outcomes. See Table 2.

AI literacy for educators involves understanding AI concepts, critically evaluating technologies, and collaborating effectively. It emphasises competencies like knowledge, evaluation, and ethics. DS, on the other hand, focusses on critical thinking, problem-solving, and ethical considerations when working with data and AI technologies. Educators must develop digital literacy and navigate digital platforms to effectively incorporate AI into their teaching methods (Bekiaridis & Atwell, 2024). Proficiency in using AI tools and personalised learning experiences is crucial for improving learning results, promoting fairness, and reducing risks in education.

Practical skills like data interpretation and visualisation are essential for AI and DS literacy. AI education for non-technical learners requires clear definitions and understanding of AI concepts. Advanced technical skills, like complex algorithm development, may not be suitable for non-technical educators.

Table 2. *Unified AI and Data Science Literacy Framework for Educators*

Knowledge Area	Definition	Examples of Competency
AI Foundations in Education	An understanding of the fundamental concepts, principles, and applications of AI in educational settings.	Knowledge of basic AI, algorithms and tools relevant to teaching and learning.
Data Science Literacy and AI Integration	Developing educators' skills in DS literacy and integrating AI technologies into teaching and learning practices.	Understanding data analysis techniques, interpreting and utilising educational data, and utilising AI tools and platforms for data-driven decision-making in education.
Ethical AI and Responsible Data Use	Promoting ethical AI practices and responsible data use in educational contexts.	Understanding ethical considerations, legal frameworks, and guidelines for the development, deployment, and use of AI tools and educational data.

Human-centric AI	AI tools and platforms that prioritise human needs, values and well-being in educational environments.	Incorporating principles of human-centred design, user experience and ethical AI to enhance teaching, learning and collaboration.
AI Pedagogy	Integrating AI tools, platforms and pedagogical approaches to enhance teaching effectiveness and student learning experiences.	Designing AI-based learning activities, assessing student progress, developing feedback mechanisms and adapting instructions to meet diverse student needs.
AI-based Personalised Learning	Designing and implementing personalised learning experiences using AI tools and platforms.	Tailoring instruction, content and feedback to individual learner needs, preferences, and learning styles, thereby enhancing engagement and learning outcomes.

5. Conclusion

The AI and DS literacy framework for educators is a comprehensive approach to developing educators' skills in AI and DS. It emphasises practical skills for integrating AI technologies into educational practices, critical evaluation of AI implications, and fostering collaborative relationships. Future work will define competencies, validate the framework, and implement competency building training to improve classroom pedagogy, enhance students' personalisation, and lead to academic success.

Acknowledgements

This work was supported by the Geran Insentif Penyelidikan untuk Pengajaran dan Pembelajaran (GIPP) research grant from the Centre for Academic Development and Leadership Excellence, UPM (Project no.: 9323860).

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>
- Bekiaridis, G., & Graham, A. (2023). Supplement to the DigCompEDU framework: Outlining the skills and competences of educators related to AI in Education. Bremen, Germany: University of Bremen, Institute Technology and Education. <https://doi.org/10.26092/elib/2708>
- Liu, Y., Huang, L., & Doleck, T. (2023). How teachers' self-regulation, emotions, perceptions, and experiences predict their capacities for learning analytics dashboard: A Bayesian approach. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-023-12163-z>
- Mandinach, E., & Gummer, E. (2013). A systematic view of data literacy in educator preparation. *Educational Researcher*, 42(1), 30–37. <https://doi.org/10.3102/0013189X12459803>
- Mohd Sharef, N., Azmi Murad, M. A., Mansor, E. I., Nasharuddin, N. A., Omar, M. K., & Rokhani, F. Z. (2021). Personalized learning based on learning analytics and chatbot. *Proceedings of the 2021 1st Conference on Online Teaching for Mobile Education (OT4ME)*, Spain, 35-41. <https://doi.org/10.1109/OT4ME53559.2021.9638893>
- Ndukwe, I. G., & Daniel, B. K. (2020). Teaching analytics, value and tools for teacher data literacy: a systematic and tripartite approach. *International Journal of Educational Technology in Higher Education*, 17, 22. <https://doi.org/10.1186/s41239-020-00201-6>
- Overton, M., & Kleinschmit, S. (2023). Transforming research methods education through data science literacy. *Teaching Public Administration*, 41(2), 149-169. <https://doi.org/10.1177/01447394221084488>
- Stolpe, K., & Hallström, J. (2024). Artificial intelligence literacy for technology education. *Computers and Education Open*, 6, 100159. <https://doi.org/10.1016/j.caeo.2024.100159>
- UNESCO. (2023). Drafts of the AI competency frameworks for school students and teachers. <https://www.unesco.org/en/digital-education/ai-future-learning/competency-frameworks>
- Zheng, J., Huang, L., Li, S., Lajoie, S. P., Chen, Y., & Hmelo-Silver, C. E. (2021). Self-regulation and emotion matter: A case study of instructor interactions with a learning analytics dashboard. *Computers & Education*, 161, 104061. <https://doi.org/10.1016/j.compedu.2020.104061>