THE ROYAL SOCIETY

Education in the age of AI: developing AI-literate citizens

Summary of a roundtable held on 17 January 2025

Background

This workshop note is derived from a roundtable convened by the Royal Society on 17 January 2025. It presents an exploration of the facets that young people will need to become literate in technologies that utilise Artificial Intelligence (AI). It considers the foundations of an AI literacy that fosters young people's technological proficiency, critical thinking, and ethical understanding, and the challenges of provisioning these in the UK. This document is not a verbatim record, but a summary of the discussions that took place during the event and the key points raised. Comments and recommendations reflect the views and opinions of the speakers and not necessarily those of the Royal Society.

Context

AI models are not only transforming scientific research[1], but are increasingly embedded in everyday life, influencing how people work, learn, and interact with the world[2]. Technology skills and digital literacy are among employers' top requirements[3]. Every sector is likely to be augmented in some way[4] as AI is deployed on repetitive tasks, influences decision-making, and raises optimism for new efficiencies. In January 2025, the UK Government launched an AI Opportunities Action Plan that aims to shape the integration of AI into the UK economy. This was followed in June by its announcement of a new programme to support secondary school students learn about technology and AI skills[5].

In an increasingly data-driven world, the ability to understand, evaluate, and interact responsibly with AI is becoming fundamental to preparing young people for the future. However, significant challenges remain. The rapid pace of technological and commercial advancements has outstripped the development of clear guidelines and guardrails for AI in education, leaving a 'literacy vacuum'. Although there is consensus on the need for action, agreement on the precise skills, knowledge, and pedagogical models required remains unresolved. For young people to be fully equipped in this context, foundational AI literacy must be integrated into national education, building on existing efforts like UNESCO's AI competency framework[6] and the University of Edinburgh's AI literacy handbook[7]. Such initiatives offer a starting point for establishing coherent, scaffolded approaches that prepare learners to engage critically with AI while recognising its potential frailties and ethical complexities.

AI literacy lies at the intersection of scientific, information, and data literacy. It is not only a matter of fostering technical skills but also of empowering individuals to critically engage with AI's ethical, social, and economic dimensions. As AI technologies evolve and become increasingly entangled with human experience, and in some areas mimic human behaviours, there is a pressing need to address their frailties and demystify AI through education.

1 The Royal Society, 2024, *Science in the age of AI*. See https://royalsociety.org/news-resources/projects/science-in-the-age-of-ai (accessed 14 May 2025).

2 The Royal Society, 2018, *Portrayals and perceptions of AI and why they matter.* See https://royalsociety.org/-/media/policy/projects/ai-narratives/ai-narratives-workshop-findings.pdf (accessed 14 May 2025).

3 World Economic Forum, 2023, *Future of jobs report 2023.* See https://www3.weforum.org/docs/WEF_Future_of_Jobs_2023.pdf; Deloitte, 2020, *Talent and workforce in the age of AI.* See https://www2.deloitte.com/content/dam/insights/us/articles/6546_talent-and-workforce-effects-in-the-age-of-ai/DI_Talent-and-workforce-effects-in-the-age-of-AI.pdf (accessed 14 May 2025).

4 Statista, 2023, *Expected change or replacement of jobs by artificial intelligence (AI) globally from 2023 to 2028.* See https://www.statista.com/statistics/1449181/ai-changes-and-replacement-of-jobs/ (accessed 17 July 2025).

5 Department for Science, Innovation and Technology, 2025, *AI Opportunities Action Plan.* See https://www.gov.uk/government/publications/ai-opportunities-action-plan/ai-opportunities-action-plan (accessed 14 May 2025); Prime Minister's Office, 2025, PM launches national skills drive to unlock opportunities for young people in tech. See https://www.gov.uk/government/news/pm-launches-national-skills-drive-to-unlock-opportunities-for-young-people-in-tech (accessed 13 June 2025).

6 UNESCO, 2024, *AI competency framework for students.* See https://unesdoc.unesco.org/ark:/48223/pf0000391105 (accessed 14 May 2025).

7 University of Edinburgh, 2025, *Teach AI Literacy Handbook*. See https://dataschools.education/teach-ai-literacy-handbook/ (accessed 13 June 2025).

The state of computing education in the UK reflects both progress and persistent challenges. While strides have been made, the focus of computing education has fluctuated over the years, oscillating between coding and core digital literacy skills, resulting in an inconsistent approach that neither addresses the needs of all students nor provides a suitable foundation for nurturing the computer scientists of the future. Persistent shortages of specialist computing teachers further exacerbate these challenges, as does the limited scope of a single computer science GCSE that fails to engage all learners or provide the broad, transferable skills they require. Many young people face a skills gap after leaving school, with insufficient preparation for technological futures in both academic and vocational pathways.

Despite growing interest in computing among women and disadvantaged groups, gender diversity remains a critical issue, with computing being the least popular STEM subject among females. As AI and digital technologies increasingly shape the future of work and society, there is an urgent need for a broad and balanced curriculum that equips young people with digital literacy, computational thinking, and critical social skills for interacting with technology.

A cohesive national strategy is essential to ensure every student can access high-quality education suitable for an AI future. Recent government announcements present a valuable starting point. However, the ambitions they contain need to be underpinned by a coherent approach to integrating critical social skills into the compulsory (pre-16) curriculum. Ensuring fundamental AI literacy is embedded in education will mean that the nation is well-positioned to become a global leader over the longer term, and that all citizens are able to critically engage in a world entangled with AI.

Components of AI literacy

AI is becoming increasingly integrated into life and work. A foundational understanding of AI knowledge and skills needed for life and work is therefore essential for all young people, regardless of whether they should choose to pursue advanced study or careers in computer science and AI. However, the current landscape presents a confused picture, with varying interpretations of what constitutes essential AI literacy. To address this, there is a pressing need to establish consensus on the specific combination – and cognitive demand – of knowledge and skills young people require, alongside a clear strategy for how these can be effectively 'scaffolded' and coherently sequenced within the national curriculum, ensuring a comprehensive and unified approach.

AI literacy is not solely a technical pursuit. While core knowledge of computing and data is essential, young people must also understand the wider social systems that shape and are shaped by AI. AI demands both technical fluency and critical social awareness. The following sections outline the key competencies needed across these two dimensions.

Technical knowledge and practical skills

Building AI literacy into education relies on helping students develop a solid foundation of technical knowledge and skills. The computing curriculum already contains many elements that provide a basis for this development, but these should be adapted and expanded to meet the specific demands of AI-focused learning.

- **Foundational computing knowledge**
  The computing curriculum introduces students to critical concepts like algorithms, programming, and computational thinking, which are essential for understanding how AI systems function. These foundational competencies enable students to grasp the logic and processes that underpin AI technologies, from decision trees to neural networks. Understanding the core concepts about the technology ensures that learners can move beyond passive interaction with AI tools to becoming active participants in their development and use.
- **Probability**
  An understanding of probability is central to many AI processes, including machine learning algorithms and decision-making systems. Concepts such as conditional probability, randomness, and uncertainty play a vital role in helping students comprehend how AI models make predictions and manage data variability.
- **Processing data**
  A common element of AI applications is the ability to process large volumes of data. Young people need to be confident in their own ability to process, interpret, and derive insights from datasets to understand how these AI models function. Students should also be introduced to data processing tools and methods, enabling them to understand the challenges and opportunities associated with big data. This topic may also trigger discussions on data ethics and governance.
- **Critical information literacy**
  While current education systems focus on evaluating claims, they often neglect the vital skill of assessing the credibility of sources[8]. This leaves students vulnerable to being misinformed, particularly when engaging with AI systems that can convincingly present biased or unreliable content as credible fact. Education programmes should foster intellectual humility by teaching students to critically evaluate expertise and question the context of information[9].
- **Applications**
  Understanding and engaging with real-world applications of AI is a crucial aspect of building young people's technical knowledge. Incorporating hands-on activities, such as experimenting with AI tools for image recognition, natural language processing, or predictive analytics, can help demystify the technology and allow students to explore its possibilities.

Critical social and human skills

Developing AI literacy in education also requires fostering critical social skills that enable students to engage thoughtfully and responsibly with AI technologies. While technical knowledge is essential, these social competencies are equally vital, equipping students to navigate the ethical, communicative, and collaborative challenges posed by AI in a rapidly evolving world.

8 Osborne J & Pimental D, 2023, *Science education in the age of misinformation.* See https://doi.org/10.1002/sce.21790 (accessed 14 May 2025).

9 The Royal Society, 2025, *Building adult community resilience to disinformation during health emergencies through information literacy.* See https://royalsociety.org/-/media/policy/publications/2025/building-adult-community-resilience-to-disinformation.pdf (accessed 14 May 2025).

- **Communication skills**
  Students should develop strong oracy and interpersonal skills to effectively use, or decide not to use, generative AI. This includes understanding the purpose and context of interactions with AI, such as framing prompts and interpreting responses. Over-reliance on AI for communication risks diminishing interpersonal skills, so it is vital to emphasise the unique value of human attributes, such as creativity, empathy, and adaptability[10].
- **Bias awareness**
  Students should learn to critically evaluate AI outputs by identifying bias in language, images, or data representation and understanding its cultural and systemic origins. By engaging with real-world examples of bias and discussing its implications, students can develop deeper understanding and critical evaluation skills[11].
- **Judgement and evaluation**
  Students should develop the ability to assess the credibility, reliability, and validity of information and apply it to AI-generated content. This involves teaching logical reasoning to identify flaws in argumentation, analysing the validity of AI-provided data, and evaluating whether the correlations underpinning AI-driven outputs sufficiently justify the conclusions presented. Meta-cognition – the ability to reflect on one's own thinking – can enhance this by encouraging students to articulate their reasoning and evaluate why information might be inaccurate or unreliable.
- **Self-direction**
  Students should begin to develop the judgement to recognise when AI might usefully support their work while maintaining a clear sense of the unique value of their own ideas, decisions, and understanding. This involves understanding how AI can support productivity while maintaining autonomy and control over decisions. Additionally, students should learn how to interpret and respond to AI-generated feedback to improve their skills and understanding, ensuring they use AI as a means to develop their cognitive skills rather than as a crutch that fosters dependency.
- **Values and ethical reasoning**
  Students should be able to critically evaluate the implicit value systems embedded in AI systems. These value systems are shaped by the cultural, societal, and philosophical biases of their developers and the data used to train them. By examining how AI reflects these assumptions, students can assess a model's design and understand their influence on outcomes and societal impacts. This is essential for identifying potential harms, such as reinforcing stereotypes or perpetuating systemic inequalities, and for fostering ethical, responsible use of AI.
- **Systems thinking**
  Students should be able to critically evaluate the interconnected impacts of AI across social, economic, and technological systems, encouraging holistic thinking. For example, they should analyse AI's role in climate change approaches alongside its environmental costs to understand complex trade-offs. Students should be encouraged to interrogate questions of sustainability, governance, and equity. By examining these broader structures, students can develop a more grounded and critical perspective on the role AI plays in society.
- **Digital agency**
  Students should be able to manage exposure to digital challenges and resist manipulative AI behaviours. This includes fostering habits that support mental and emotional well-being – such as managing screen time, identifying misinformation, and engaging in 'digital detox' practices – while also cultivating the confidence and agency to challenge digital systems and make informed choices about when and how to engage with AI-driven technologies.

10 The Royal Society, 2024, *The United Nations' role in international AI governance.* See https://royalsociety.org/-/media/policy/publications/2024/un-role-in-international-ai-governance.pdf (accessed 14 May 2025).

11 The Royal Society, 2025, *Building adult community resilience to disinformation during health emergencies through information literacy.* See https://royalsociety.org/-/media/policy/publications/2025/building-adult-community-resilience-to-disinformation.pdf (accessed 14 May 2025).

CASE STUDY

Parliament Hill School

Parliament Hill School, a state secondary school for girls in North London, has taken a pioneering approach to AI literacy. With around 1,200 pupils, 35% of whom are eligible for Free School Meals, the school prioritises inclusivity and social action. Recognising AI's rapid evolution, the school has adopted a student-led approach to understanding and integrating AI into education.

Originally a student leadership project, the AI literacy programme has expanded school-wide. Rather than implementing rigid policies, the school focuses on fostering a deep understanding of AI's capabilities and implications. Students collaborated with a parent volunteer to explore AI functionalities using the Google DeepMind Raspberry Pi toolkit. They trained AI models to differentiate between objects, tested AI's ability to distinguish voices and biases, and applied AI to real-world interests such as nail art design and mnemonic song creation for revision.

The programme extends beyond students. Nine teachers have undertaken AI professional development, moving beyond workload automation to using AI for differentiation, formative assessment, and creative engagement. Challenges include a shortage of computing specialists and limited classroom devices. To address this, the school aims to train teaching assistants as AI facilitators.

The shift in AI literacy at Parliament Hill has been significant. Initial concerns about AI misuse have evolved into discussions on effective implementation, with students using AI to enhance subject knowledge rather than bypass learning.

Looking ahead, Parliament Hill School plans to embed AI literacy into whole-school professional development and formalise an AI policy that balances structured guidance with adaptability. The governing body has recognised the importance of AI in education, with plans for AI-specific discussions at upcoming meetings.

Considerations for implementation

To achieve the UK's ambitions for AI-driven economic growth and improved public services[12], the education system needs a coherent[13] and cohesive strategy to ensure quality, consistency, and equity. This would need to include:

- **Cross-curricular strategies**
  AI has applications and uses across all facets of human activity so the responsibility for developing AI literate citizens should be shared by teachers of all subjects. While cross-curricular implementation is challenging, it offers a holistic way to demonstrate AI's relevance and challenges to everyday life. AI's applications in geography (eg environmental data analysis) or product design (eg prototyping with AI tools) can serve as open doors for developing interdisciplinary learning opportunities.

  This need for a cross-curricular approach to developing young people's AI literacy corresponds with the mathematics education community's view that responsibility for mathematical and data education should be shared by all teachers to equip future citizens with the adaptability and resilience needed in a fast-changing, data-rich world[14].

- **Curriculum design**
  A well-designed curriculum is critical for providing a benchmark expectation that helps promote equitable access to skills and knowledge, guiding teachers in delivering focused and practical AI literacy lessons, and steering the wider sector in their support of schools. Restoring probability, emphasising data-driven approaches, and prioritising critical skills are essential steps to ensure that students can navigate an AI-driven world.

- **Assessment**
  Effective assessment methods are crucial for measuring and supporting AI literacy and should focus on the technical understanding and critical social skills outlined. While the effectiveness and uptake of small modular certifications or 'driving licence'-style qualifications that assess competencies have been inconsistent[15], there is a growing need to modernise assessment to better reflect the challenges of an AI-driven world.

- **Supporting teachers**
  Teachers play a pivotal role in fostering AI literacy, especially those who act as champions within their schools. To fulfil this role effectively, they need access to professional development opportunities that build their confidence and competence in AI concepts. In an AI-impacted world, teachers will be instrumental in facilitating human-centred interactions that nurture critical thinking and social development in young people, alongside their technical skills. Teacher training programmes, including the Core Content Framework, should be adjusted to include greater focus on this responsibility.

- **Structural incentives**
  For AI literacy to be valued, it must be recognised as a critical component of education. For example, computing is currently underrepresented in school evaluations. Ensuring AI literacy is prominently evaluated in inspection frameworks would signal its importance to schools and drive more consistent provision across schools, both in individual subjects and wider cross-curricular support[16]. Additionally, efforts should explore what motivates students and parents to value AI education, aligning activities with student interests and future opportunities. Examples could include interactive AI challenges, simulation games, or AI-focused STEM competitions.

12 Department for Science, Innovation and Technology, 2025, *AI Opportunities Action Plan*. See https://www.gov.uk/government/publications/ai-opportunities-action-plan/ai-opportunities-action-plan (accessed 14 May 2025)

13 Oates T, 2010, *Could do better: Using international comparisons to refine the National Curriculum in England.* See https://www.cambridgeassessment.org.uk/Images/124223-tim-oates-paper-could-do-better-using-international-comparisons-to-refine-the-national-curriculum-in-england.pdf (accessed 14 May 2025).

14 The Royal Society, 2024, *A new approach to mathematical and data education.* See https://royalsociety.org/news-resources/projects/mathematical-futures/ (accessed 14 May 2025).

15 Tamoliune G *et al*, 2023, *Exploring the potential of micro-credentials: A systematic literature review.* See https://doi.org/10.3389/feduc.2022.1006811 (accessed 14 May 2025).

16 Ofsted, 2024, *Ofsted's approach to artificial intelligence.* See https://www.gov.uk/government/publications/ofsteds-approach-to-ai/ (accessed 14 May 2025).

- **Cost implications**
  There are significant infrastructure and resourcing challenges to implementing AI tools and strong AI literacy strategies in schools. There are still 3,000 schools without access to full fibre broadband[17], and over half of senior leaders have cut spending on technology and IT equipment due to financial constraints[18]. However, these challenges need to be addressed so that there is equitable access to AI tools and literacy resources, especially in underserved areas. Providing universal access to foundational AI literacy education will ensure that opportunities in the digital economy serve the public good, are not limited to those pursuing advanced studies, and contribute to closing existing equity gaps.
- **Providing 'safe playgrounds'**
  Establishing safe and supportive environments for students to engage with AI is important for fostering AI literacy in a responsible and age-appropriate manner. Clear guidelines should ensure age restrictions for AI use, mandatory transparency in identifying AI-generated content, and ethical safeguards that prioritise the well-being of young learners. Age-appropriate and interactive learning environments, such as AI-driven games, virtual labs, and sandboxes, offer students opportunities to experiment with AI's capabilities, limitations, and ethical dimensions in a controlled and guided manner. These tools encourage experimental play, promoting curiosity and critical thinking while avoiding anthropomorphism or misinterpretations of AI's role. By providing these "safe playgrounds," educators can support students in developing a nuanced understanding of AI and its implications, ensuring they are prepared to navigate its complexities responsibly.
- **Research**
  Further research is needed to identify and evaluate best practices in AI literacy education. This requires dedicated funding to support pilot programmes and longitudinal studies, ensuring that AI literacy initiatives are evidence-based and scalable. The UK's investment in education research remains disproportionately low compared to other public sectors such as health, leading to fragmentation, and underinvestment in emerging areas, including AI education[19]. Countries like Singapore and the Netherlands have invested significantly in educational research focused on integrating technical components of AI literacy, examining pedagogical strategies, teacher training, and long-term outcomes, which inform evidence-based national frameworks. In comparison, while the UK has initiated research efforts, they often lack the same level of coordination and focus on evaluating scalable implementation strategies, leaving a gap in systematically applying findings to shape educational practice.

17 UK Parliament, 2022, *Schools: broadband: question for Department for Education.* See https://questions-statements.parliament.uk/written-questions/detail/2022-07-05/31183 (accessed 14 May 2025); Department for Education, 2021, *Education technology (edtech) survey 2020-21* – 25% of teachers view broadband connectivity in school as a big barrier to edtech uptake. See https://assets.publishing.service.gov.uk/media/621ce8ec8fa8f54915f43838/Education_Technology_EdTech_Survey.pdf (accessed 14 May 2025).

18 Sutton Trust, 2024, *School funding and pupil premium 2024.* See https://www.suttontrust.com/our-research/school-funding-and-pupil-premium-2024/ (accessed 14 May 2025).

19 The Royal Society, 2024, *Investing in a 21st-century Educational Research System.* See https://royalsociety.org/-/media/policy/projects/education-research/investing-in-a-21st-century-educational-research-system.pdf (accessed 14 May 2025).

Conclusion

Artificial Intelligence is already influencing the social and economic contexts in which young people live and learn, often in ways that are fast-moving and difficult to discern. Based on the evidence and perspectives shared by participants at the Royal Society in January 2025, we need to prepare future citizens not only to use these technologies but to critique them and shape them responsibly. AI literacy must therefore become a central thread running through education reform. This is not a matter of simply adding new content to the curriculum, but of reimagining the knowledge, skills, and dispositions needed to thrive in a technological world.

The opportunity, and the challenge, was sharply articulated by attendees. Without concerted action to implement critical AI literacy, existing disparities in access to digital tools and understanding will deepen, and we risk leaving a generation underprepared for the ethical, cognitive, and civic demands of AI in society. The conditions for change are emerging: there is growing consensus on the need for a more coherent, cross-curricular, and values-led approach to AI education; promising models of practice are developing in schools and colleges; and national strategies are beginning to acknowledge the role of education in the broader AI ecosystem.

Informed by the insights shared at the roundtable, the Royal Society will be supporting the development of AI literacy in young people in the UK. We will continue to convene diverse expertise across sectors, contribute to the evidence base for effective and equitable AI education, and engage with policymakers across the four nations to ensure that emerging strategies are ambitious, inclusive, and grounded in best practice. As this work progresses, we will continue to make the case that education about AI must not only reflect the pace of technological change, but anticipate its social consequences and prepare young people to meet them with confidence, criticality, and care.

Acknowledgements

The Royal Society would like to thank the following people for contributing to this event.

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