WORLD ECONOMIC FORUM

Shaping the Future of Learning:
Education Readiness for the Age of AI

INSIGHT REPORT

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Images: Unsplash

Contents

Executive summary

Artificial intelligence (AI) is fundamentally transforming how humans access, produce and apply knowledge. The central challenge lies not in AI adoption itself, but in the growing misalignment between rapidly changing technological availability, learning behaviours and education systems that are ill-equipped to accommodate them. Such transformation challenges the long-standing assumptions about individual learning, collective human capital development, the purpose of education and the value of human skills, particularly as investments in developing information technologies may soon outpace investments in developing human capital.

AI adoption is happening from the bottom up, as students and educators incorporate these tools into daily learning without corresponding updates to curricula, assessments or governance. This creates structural tension: education systems are designed to evolve deliberately, prioritizing equity, trust and quality, while AI spreads rapidly and reshapes learning behaviours faster than systems can adapt. The implications extend beyond learning outcomes. AI challenges the core functions of education systems, including knowledge and skill development, assessment credibility, equitable access and the social and emotional foundations of learning.

Learning outcomes will not be determined by technology itself, but by the conditions in which it is deployed. Although many AI tools were not initially built for educational purposes, advances in algorithms and datasets have enhanced their capacity to support learning. However, isolated and fragmented interventions across policy, pedagogy and technology are unlikely to be sufficient. System-level outcomes emerge from interactions across multiple levels: governance, institutions, educators and learners. When these levels are not aligned, even well-intentioned innovations are unlikely to realize the benefits of AI and may even produce unintended consequences. It is worth noting that evidence from controlled studies does not always translate reliably to large-scale implementation, where context, incentives and capacity can vary significantly — reinforcing the need for adaptive, system-wide approaches rather than fixed solutions.

This paper is part of a broader body of work under the Education 4.0 initiative. A previous report in this series, *Shaping the Future of Learning: the Role of AI in Education 4.0*, focused in depth on the opportunities AI offers for education systems. By contrast, this paper intentionally places greater emphasis on risks and system readiness conditions, reflecting the need for a more balanced perspective as adoption accelerates. Addressing these conditions requires a shared language and a coordinated, multi-level response. The paper therefore introduces an AI Readiness Framework designed to help stakeholders assess whether the necessary conditions are in place to support effective, equitable and trustworthy integration of AI into education. The framework was developed through consultations with members of the Forum's Education 4.0 Alliance, the Global Future Council on Human Capital Development, and educational experts.

To support practical application, the framework defines a set of readiness signals, observable indicators that help stakeholders identify gaps, prioritize action and align efforts across levels. These signals are not prescriptive checklists, but practical reference points that support informed dialogue and encourage collaborative action across policy-makers, educators, technology providers and society. Given the uncertainty surrounding AI's long-term impact, these signals are intended to support continuous innovation and iterative learning rather than fixed implementation pathways.

The urgency of this agenda is growing. Without coordinated action, the risks associated with AI, such as cognitive offloading, misinformation, erosion of academic integrity and loss of human connection, are likely to intensify. At the same time, the potential benefits of AI, including reducing administrative burden, enabling scalable feedback, and expanded access to learning may remain unevenly distributed and unrealized without the right system conditions

The World Economic Forum's role is to convene stakeholders across sectors to address complex, systemic challenges. In this context, the framework is intended not only as a diagnostic tool, but as a common reference point for collaboration, helping align diverse actors around shared objectives for the future of learning.

Ultimately, the question is not whether AI will shape education systems, but whether education systems will shape how AI is used. Building readiness today will determine whether AI strengthens human learning and development or undermines it.

Introduction

Over recent decades, the relationship between people, information and knowledge has undergone a profound transformation. The internet, digital platforms, social media and artificial intelligence have radically expanded the ways in which information is produced, shared and accessed. For the first time, a widely accessible technology can perform cognitive tasks such as writing, analysis, reasoning, and synthesis, tasks that education systems are specifically designed to develop. Technologies expanded our ways to acquire new knowledge, allowing more learning to take place outside formal institutions across a vast array of digital platforms.[1] Some are built for learning purposes, but some are not. Many institutions and structures that society has designed for learning are being challenged while new ways to learn emerge.

These shifts create both opportunity and uncertainty. On the one hand, individuals can now learn, create, teach and exchange with unprecedented freedom. Online platforms, forums, social media, chatbots and other digital tools have become powerful, informal learning environments – flexible, responsive, easy to use and open to millions of connected users. As individuals increasingly access, generate and apply knowledge outside formal institutions, questions of quality, structure and validation become more acute. In the absence of consistent guidance, learning pathways risk becoming more fragmented and their outcomes more uneven.

The core issues are not just access to information or technology, but whether education systems can maintain their role as the primary institution through which societies develop human capability, verify knowledge and ensure equity of opportunity. Evidence shows that providing everyone a fair chance in quality education is one of the most effective ways to strengthen both social and economic outcomes.[2] Yet without robust institutional frameworks and governance mechanisms, the opportunity presented by technological innovation to expand and enrich learning may not be fully realized.

Education systems must adopt AI intentionally, recognizing that it is fundamentally different from previous educational technologies. Unlike earlier tools such as laptops, learning management systems or internet connectivity, AI does not simply deliver content or connect users; it generates explanations, reasoning and solutions. This requires grounding decisions in evidence of authentic learning impact, while acknowledging that evidence remains partial, context-dependent, and difficult to scale across systems. At the same time, education leaders must move beyond reactive experimentation and develop long-term strategies for human capital development and institutional capacity.

Education systems today often operate and make critical decisions with limited evidence, while confronting conflicting narratives, rapid advances and significant uncertainty about the trajectory of AI. Making sense of technological change, therefore, requires clear, shared frameworks that help stakeholders filter noise, organize emerging practices and align technology adoption with human development goals. Providing the foundation for collective action is critical to ensure innovation strengthens rather than destabilizes learning ecosystems. The objective of the framework (Figure 1) presented in this paper is to offer precisely this kind of shared reference point – one that all investors in human capital across education, technology, government and society can use to guide the collaboration.

FIGURE 1 | **Education system readiness framework for AI integration**

Source: World Economic Forum.

The framework is grounded in a review of the relevant literature and empirical trends, as well as consultations with leading experts in the field, and it outlines the key elements necessary for education systems to adopt AI responsibly and effectively. By clarifying conditions that must be in place before adoption, the framework aims to turn uncertainty into deliberate, collaborative action.

One central insight – that the challenges AI poses to education are systemic, not sectoral – underpins the framework. These challenges arise from the interaction between policy gaps, institutional inertia, pedagogical uncertainty and unguided learner behaviour. Addressing them requires, and the framework aims to enable, moving beyond isolated interventions toward a coordinated approach that recognizes how conditions at each level of the system shape outcomes at every other level.

Education systems operate under widely differing conditions, including variations in resources, institutional capacity, cultural context and stages of development. As such, readiness for AI integration cannot be understood as a uniform or linear progression. There are many education systems that already succeed in some components of the framework, such as improved digital connectivity, the adoption of AI literacy frameworks, the embrace of personalized learning approaches and the safeguarding of children's privacy online. While each category is valid and important, the framework encourages a holistic, collaborative approach that extends beyond the responsibility of any single stakeholder.

The framework is therefore intended to support differentiated applications, helping identify context-specific priorities while maintaining a shared structure for analysis and dialogue. Recognizing this difference is essential to ensuring that AI adoption supports equity rather than widening existing gaps.

The following sections unpack the forces that make this moment pivotal for education – the new economic and technological contexts, the existing approaches to adopting AI in education, opportunities and risks that will shape AI's long-term impact, and more details about the framework. The final section outlines in greater detail the readiness signals that can support stakeholders such as policy-makers, education leaders, and technology product innovators.

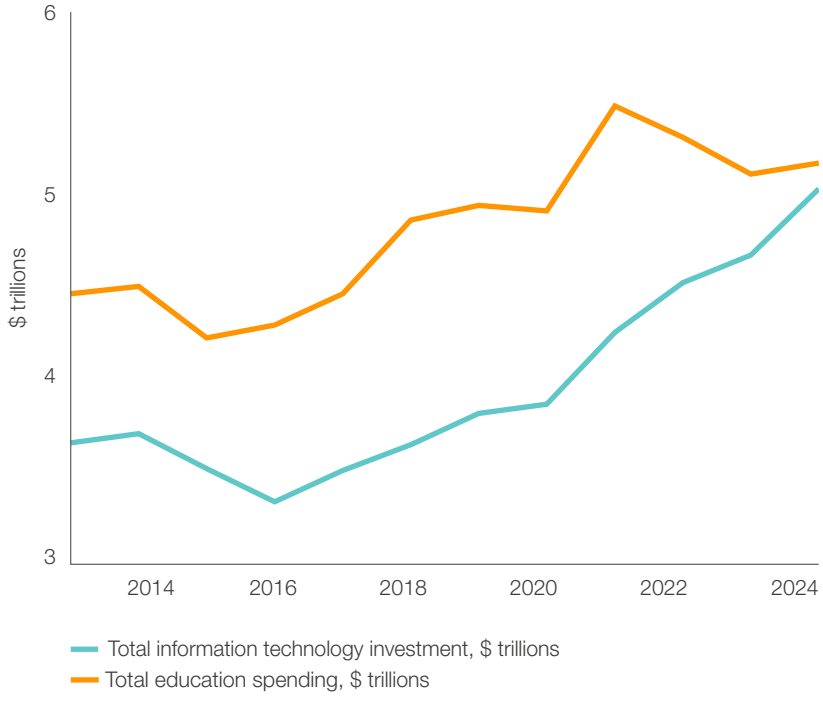
1 The new context for education

1.1 Shifting economic landscape

Throughout history, major technological transformations have reshaped the nature of work, socioeconomic structures and, with them, the demands placed on education systems. Industrial transformations required societies to expand access to mass schooling to prepare workers for factory production.[3] Later, the spread of computers and information technologies increased the demand for higher education, analytical capabilities and digital fluency.[4]

Each technological wave altered the skills requirements demanded in the labour market and forced education systems to evolve in response.[5] This historical pattern matters because it reveals a core function of education: to align human capability with economy and society. When that alignment holds, both individuals and societies benefit. When it breaks down, inequality grows and public trust in education weakens.

FIGURE 2 **Global spending on education and investment in information technologies, $ trillions, 2013–2024**



Source: Source: World Bank, International Monetary Fund (IMF), Gartner.

Rapid technological change, driven by digitalization, automation and AI, is transforming global economies and reshaping the demands placed on education systems. In this context, individuals' ability to develop and apply cognitive, digital and adaptive skills determines how effectively they can participate in and benefit from technological change. Expanding access to secondary and tertiary education has acted as a powerful equalizer throughout much of the twentieth century, helping economies absorb technological change and expand economic opportunity. Where education systems failed to expand, either in coverage or in quality, inequality grew.[6]

Even though schooling commands an obvious wage premium[7] there is recently growing scepticism that academic credentials will lead to economic opportunity in the new economy.[8] The relationship between credentials and labour-market value is becoming more complex. In previous decades, technical and academic qualifications delivered high returns because they reliably signalled mastery of required skills.[9] Today, that signal is weakening. Skills requirements are evolving faster than qualification frameworks can track, and employers increasingly find it difficult to articulate what they need, while jobseekers find it equally difficult to demonstrate it. When education systems fail to bridge that gap, the consequences reach beyond careers.

These economic stakes are significant. Modern economies are increasingly organized around knowledge creation, application and exchange. What economists have described is a shift toward knowledge-intensive production, in which competitive advantage derives less from physical capital or natural resources and more from the accumulation of ideas, skills, know-how and workforce capabilities.[10] Economies that succeed in developing and accumulating human capital tend to succeed economically.

Today, economies are steadily investing in information technologies to accelerate the analysis, exchange and creation of knowledge. At the same time, global investment in human capital development has been growing slower than the global economy. Looking ahead, there is no forecast for a breakthrough in education spending over the next few years; however, investments in information technology are solid, with capital expenditures on AI alone forecast to more than double between 2024 and 2026 (Figure 2).[11]

The decoupling between productivity and labour value has been widely documented since the 1970s. In knowledge-intensive economies, the rapid advancement of information technologies like AI is further reshaping this dynamic by altering how human skills might contribute to economic output in the future, how work is performed and how human contribution is measured.

This raises important questions for education systems. While economic return is not the sole objective of education, systems must deal with these shifts to ensure that learning continues to support both human development and economic participation.

Education has long served multiple, interrelated functions: developing human capabilities, transmitting and validating knowledge, enabling economic opportunity, and sustaining civic and social life. AI is beginning to challenge on each of these functions, simultaneously altering how knowledge is produced and assessed, reshaping the skills that support economic participation, and influencing the social and relational dynamics through which learning occurs. Understanding these challenges is essential to assessing both the risks and opportunities AI presents for education systems.

These pressures manifest as both risks and opportunities: AI can undermine these core purposes when poorly integrated, but it can also enhance them when aligned with clear educational objectives and system-level conditions.

Despite this growing uncertainty, individuals and families continue to invest in education, often at significant personal cost, because of a genuine belief in its value and fear of the consequences of being left behind. This individual willingness to invest reflects enduring confidence in education's role, but it also creates vulnerability. As skills requirements evolve more rapidly than formal qualification frameworks, and as AI begins to perform or augment tasks traditionally associated with higher education, the link between educational attainment and labour-market outcomes becomes less predictable. Current credentials may no longer reliably signal economically relevant skills and returns to education may increasingly vary more widely across contexts and individuals. The consequences fall disproportionately on those least able to absorb the loss, when expected returns do not materialize.

Because AI and digital technologies have been changing how skills are valued and how learning happens, education systems must adapt how they teach, assess and organize learning to remain relevant. The question is not whether to innovate, but whether today's innovations are strengthening the human-capital equation. Private innovators bring real advantages, technical expertise, investment capacity and speed that the public sector cannot match alone. Their role in educational innovation is both valuable and necessary. Yet when educational innovation is driven primarily by commercial incentives, it risks being reduced from a public good and human right to a commodity, exacerbating inequalities and concentrating benefits among those already best positioned to access them.[12] This concern is especially pertinent as commercial AI tools increasingly shape how learning is designed and delivered. Ensuring that innovation serves all learners equally requires thoughtful design and governance.

The path forward is not to limit innovation, but to shape it purposefully through genuine partnership between public institutions, private innovators, society, educators and learners themselves. When these strengths are combined, technology can expand access, reduce costs and create meaningful new opportunities for teaching and learning.

1.2 Acceleration of technological change

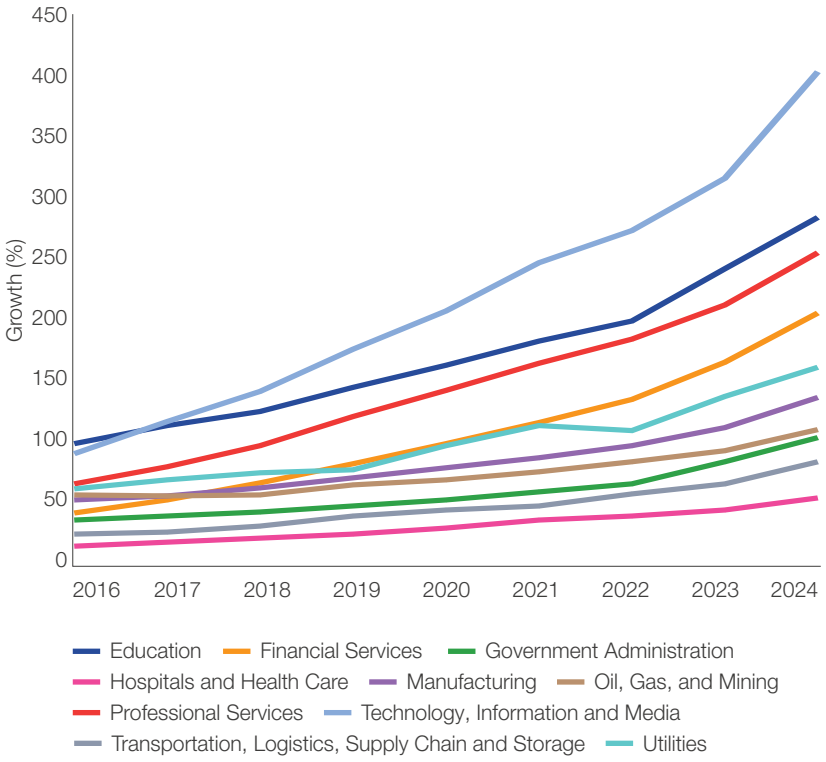
The previous section established that the alignment between education and economic outcomes is under strain. This section examines how AI adoption is compounding that challenge. It introduces a second form of misalignment: between the pace at which technology is being adopted by learners and educators, and the pace at which institutions can govern, guide and integrate it.

AI is no longer an emerging trend in education or a technology that institutions can choose to adopt at some point in the future. It has already emerged as a routine part of how millions of learners' access information, complete academic tasks and make sense of the world. The evidence for this shift is striking in both breadth and speed. Education is the second most AI-intensive sector, only behind the technology, information and media sector.

LinkedIn data shows the education sector having great AI uptake, in terms of AI-related jobs and skills, by assessing the number of AI occupations and the number of LinkedIn members with at least two reported AI-related skills for each industry (Figure 3).[13]

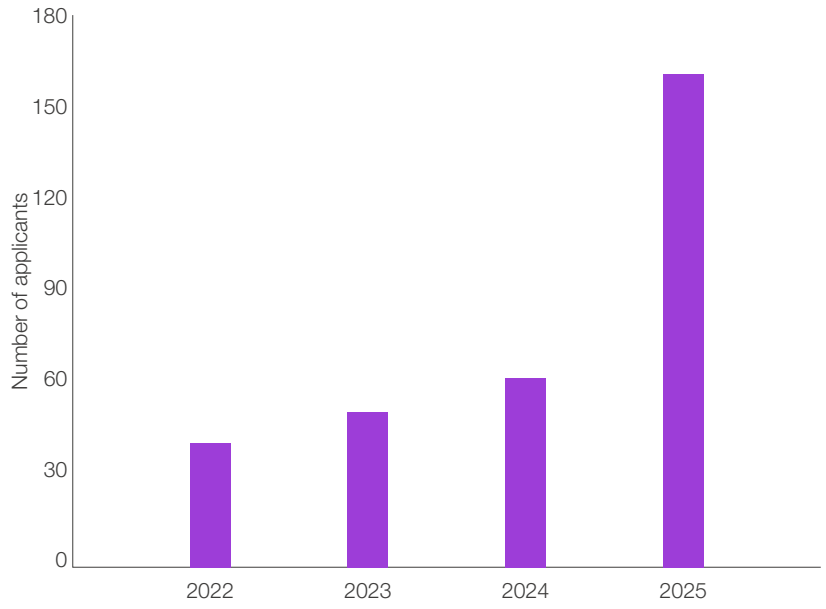
As stated in the previous chapter, growth in education spending has been slower than the overall economic growth. Public spending on education (as a percentage of global GDP) has been declining since 2021.[14] Private investment in education technology has also been sluggish since the pandemic, and the composition of private investment within this market is currently shifting away from traditional K-12 EdTech and general education platforms towards AI-driven tools.[15] This shift is also reflected in innovation trends more broadly, as data from HundrED's annual global

FIGURE 3 **Growth in relative concentration of AI technologies, by industry, 2016-2024**



Note: AI concentration by industry, relative to 2016 value of the leading industry.
Source: LinkedIn.

FIGURE 4 **AI in educational innovations, 2022-2025**



Note: Number of applicants, per year, to the Global Innovation Collection, that use AI as a solution tool in educational innovations. The Collection recognizes the top 100 impactful and scalable innovations in education.
Source: HundrED.

collection of educational innovations shows the share of submissions from applicants using AI as a tool for educational innovation quadrupled between 2022 and 2025, reaching 21.6% of all submissions (Figure 4).[16]

AI is diffusing faster than previous general-purpose technologies, catching many educational institutions off guard. Many learners have enthusiastically started using AI tools, driving the bottom-up adoption of this technology for learning. The scale and nature of this uptake are now measurable with more precision. For example, traffic data shows an interesting pattern: visits to major AI platforms rise significantly during academic term periods.[17]

Students use AI to obtain explanations, draft essays, translate texts, outline projects and solve academic tasks, outsourcing an ever-growing share of their schoolwork to machines.[18] The share of students using AI for help with their homework increased from 48% in May 2025 to 62% in December 2025, according to RAND research, even as 67% of students recognize that using it for their schoolwork may harm their critical thinking.[19] Many now turn to AI before searching the internet or consulting a textbook. This marks a fundamental shift in how learners seek information.

On the one hand, AI use reflects convenience-seeking and the effortless completion of academic tasks. On the other hand, it is also driven by growing academic pressures. A study of students in South Korea found that those experiencing higher levels of academic stress were more likely to rely on AI tools for assistance, and that overreliance was associated with lower creativity, reduced intrinsic motivation, and weaker critical thinking.[20] The conditions of pressure, heavy workloads and performance anxiety are unlikely to support thoughtful and effective use of AI.

Even as students drive the adoption, educators are also integrating AI into their daily work. A recent study of Estonian teachers found that 53.2% already use AI in their teaching, with primary school teachers reaching 66% AI tool usage.[21] The Digital Education Council's Global AI Faculty Survey (2025) found that the top use cases for AI in teaching include the creation of teaching materials (75%), support with administrative tasks (58%), teaching students how to use and evaluate AI in class (50%), boosting student engagement (45%), detecting cheating (28%) and generating feedback for students (24%).[22] These uses reflect a pragmatic response to longstanding pressures: managing workload, differentiating instruction and providing attentive feedback in ways that were previously difficult or impossible at scale.

Although generating feedback ranks lower among teachers' priorities in the Estonian study described in the previous paragraph, it remains one of educations' most critical practices and one of the hardest to deliver consistently at scale. AI offers a genuine opportunity in this area, yet its integration

is far from straightforward. Student perceptions matter. As a recent EPFL study highlights, learners have complex and sometimes cautious attitudes towards AI-generated feedback.[23] Trust between students, teachers and institutions is therefore a prerequisite for meaningful adoption. Yet that trust currently rests on shaky foundations. According to Stanford's *AI Index Report*, while most students and teachers appear to use AI tools, only 6% of teachers believe that existing AI policies provide clear guidance.[24]

Adoption patterns seem to follow a reactive sequence: teachers adopt AI in response to students, and institutions follow teachers. This reactive dynamic matters not only for the quality of integration but also for its outcomes. Evidence from large-scale studies suggests that effective AI use takes time, and experience genuinely improves the ability to work productively with AI.[25] Students and educators who adopt AI without guidance or structured practice are likely to remain on the lower end of this learning curve, limiting the value they derive from the technology.

Current research on AI in education remains limited, particularly in K-12 contexts. Much of the existing literature focuses on learners ages 18 and above, is conducted under constrained conditions, such as one-time, 20-minute experiments, and examines primarily short-term outcomes.[26] Even well-established, evidence-based approaches in education often fail to predict where innovations will scale successfully. Decision-making should ideally be grounded in evidence, but in the case of AI in education, such evidence is largely absent. If education leaders wait for conclusive findings before taking action, the window to shape AI's role in learning may have already closed.

The paradox is striking: AI is reshaping how millions of people learn, yet most learners have received no formal education on how to use it for learning. This is not simply a gap to be closed with better training. It represents a governance failure: the technology that most directly affects learning is being adopted outside institutional oversight, without alignment to educational objectives, and without mechanisms to ensure that its use supports rather than undermines learning.

This is not institutional unwillingness to innovate; it reflects a structural mismatch between the pace of AI development and the pace at which institutions can adapt their curricula, assessment mechanisms and regulations. Most education systems are designed around equity, access and broader socioeconomic goals, which require deliberation and due process before committing to change. Understanding this gap between technological availability and the purpose of education is not merely an analytical exercise; it is the starting point for the framework presented in this paper. The pattern described in this section – rapid, unguided adoption creating misalignment across system levels – is precisely what a coordinated readiness framework is designed to address.

1.3 Promises of AI in education

Supporting teacher's role: augmentation and automation

Fostering responsible AI and digital literacy

Refining assessment and decision-making in education

Personalising learning content and experience

The previous publication in this series, *Shaping the Future of Learning: The Role of AI in Education 4.0*, examined the opportunities that AI offers to strengthen education systems. Digital technologies have played a pivotal role in expanding universal access to education over recent decades, yet major concerns persist and some gaps remain wide. The report highlighted AI's potential to address persistent challenges such as high teacher workload, limited personalization of learning, and delays in assessment and feedback. As adoption accelerates, these opportunities are becoming increasingly tangible. However, none of them will be realized automatically. Each depends on system conditions, such as governance, institutional capacity, teacher capability and learner readiness, that cannot be assumed and must be deliberately built. Understanding what is at stake if these conditions are absent is as important as recognizing what is possible when they are in place.

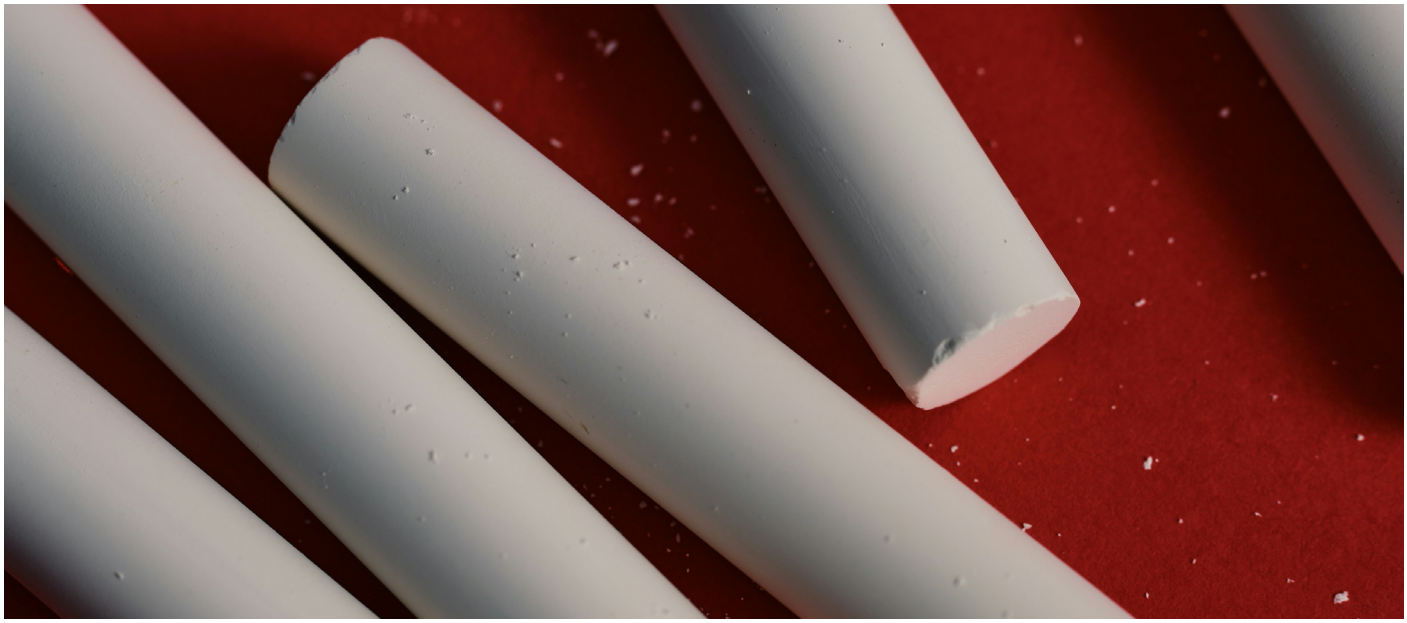
The promise of AI to support teachers and augment their work remains significant. Such opportunity is particularly valuable given the projected global shortage of 44 million teachers by 2030, with countries in the Global South the most affected.[27] AI technologies can help redefine the nature and quality of work in education by automating repetitive and administrative tasks, thereby freeing teachers to focus on higher-value activities such as individualized instruction, mentorship and creativity. Research indicates that up to 20% of teachers' time is currently spent on administrative duties that could be automated, while 8–20% of analytical tasks, such as lesson planning and performance evaluation could be augmented by AI.[28] By alleviating these burdens, AI can enable educators to devote greater attention to interpersonal interactions, emotional support and engagement with parents. However, realizing these benefits requires deliberate system design and sustained investment in teacher training to ensure educators can manage automation effectively and strengthen human-centred competencies.

Traditional assessments are often linear and time-consuming and may fail to provide timely feedback for learners. AI-driven analytics can deliver instant, personalized feedback at scale, helping learners identify errors while enabling teachers to adapt instruction in real time. Continuous assessment models can reduce reliance on high-stakes examinations, thereby promoting more engaging and adaptive learning environments. At a systemic level, AI-powered analytics can enable schools and ministries of education to detect learning gaps, forecast performance trends and make timely, data-informed decisions, transforming education management from a reactive to a more responsive and predictive model.

Integrating AI into education extends beyond the adoption of new tools; it also requires teaching students how to understand, question and responsibly apply them. Students should learn how to use AI tools, evaluate online information, recognize misinformation, and engage critically with digital learning environments while understanding the broader societal implications of AI. Teaching these competencies in schools will help prepare learners to navigate an AI-driven economy and participate as informed citizens. Embedding cybersecurity, bias awareness and data ethics into curricula ensures that students can use AI responsibly and help shape equitable technological futures.

Perhaps AI's most direct impact lies in its capacity to deliver personalized learning at scale. Building on research demonstrating the effectiveness of one-to-one tutoring.[29] AI algorithms can emulate elements of individualized instruction by adjusting content, pace and difficulty based on each student's progress, preferences and needs. They can identify learning gaps, anticipate challenges, and generate customized learning pathways, offering feedback and materials that align with learners' strengths while addressing weaknesses. Importantly, teachers must remain central in contextualizing AI-generated insights, ensuring cultural relevance, ethical use and meaningful emotional engagement with students. AI tools can also enhance accessibility through real-time translation, captioning and multimodal content delivery, thereby supporting learners with disabilities and promoting inclusive education.

Across these key opportunities, AI has the potential to amplify human capability in education, but only if the conditions are in place. Without adequate governance, these tools may be deployed without accountability. Without investment in educators, they will be adopted superficially or resisted. Without attention to equity, their benefits will concentrate among those already best served. The following section examines the risks that emerge when these system conditions are absent, and which intensify as adoption continues without a coordinated response.



2 Risks of unstructured AI adoption

Each of the following risks reflects a different way in which AI may undermine the core purposes of education systems if not deliberately managed. The risks described below are not speculative. They are already observable in education systems worldwide, and they share a common characteristic: each is made worse by the absence of the system conditions described in the readiness framework. Cognitive atrophy intensifies when pedagogy fails to adapt; misinformation spreads further when digital literacy is absent; academic integrity erodes when governance frameworks lag behind technological advances; and human connection weakens when institutions prioritize efficiency over relational learning. These are not separate problems requiring separate solutions – they are interconnected consequences of system-level misalignment.

Cognitive atrophy

Breakdown of academic integrity

Hallucinations and misinformation

Erosion of human connection

2.1 Cognitive atrophy

AI's capacity to reduce cognitive effort poses a potential threat to education, not despite its effectiveness, but because of it. The risk is pronounced for children and young people, whose neural development is still forming.

Physicist Leonard Susskind once remarked, "If necessity is the mother of invention, laziness is the father."[30] In many ways, this reflects a fundamental feature of the human brain: its tendency to conserve energy and minimize effort whenever possible. Humans naturally seek easier ways to accomplish tasks and, throughout history, societies have adopted tools that reduce mental effort. However, an important distinction exists between tools that extend human cognition and those that replace it. When a student uses a calculator to check a complex computation, their mathematical understanding remains intact. When a student uses an AI system to reason through every step of a problem-solving process, the cognitive work that would have built understanding may simply not happen.

Generative AI crosses into qualitatively new territory. Where previous tools automated routine mechanical tasks, large language models (LLMs) can now execute higher-order cognitive functions, such as drafting arguments, comparing evidence, structuring analysis and generating explanations. In automating the process of reasoning, it deprives the brain of the struggle through which understanding is built.

Research findings substantiate this: in one experiment students given access to an AI tool initially improved their performance, but once the tool was removed, they performed worse than those who never had access.[31] Learning is not a passive absorption of information but an active struggle that strengthens the neural architecture of learning.

The human brain develops through effortful engagement: neural pathways that are repeatedly activated grow more efficient through a process known as experience-dependent plasticity.[32]When those pathways lie dormant, because the cognitive work has been delegated elsewhere, they might weaken, much as muscles atrophy without use. The prefrontal cortex, responsible for thinking, focus and behavioural control, can develop into one's 30s.[33] Under-stimulating these neural pathways in children and young people could have devastating consequences for their future learning capacity.

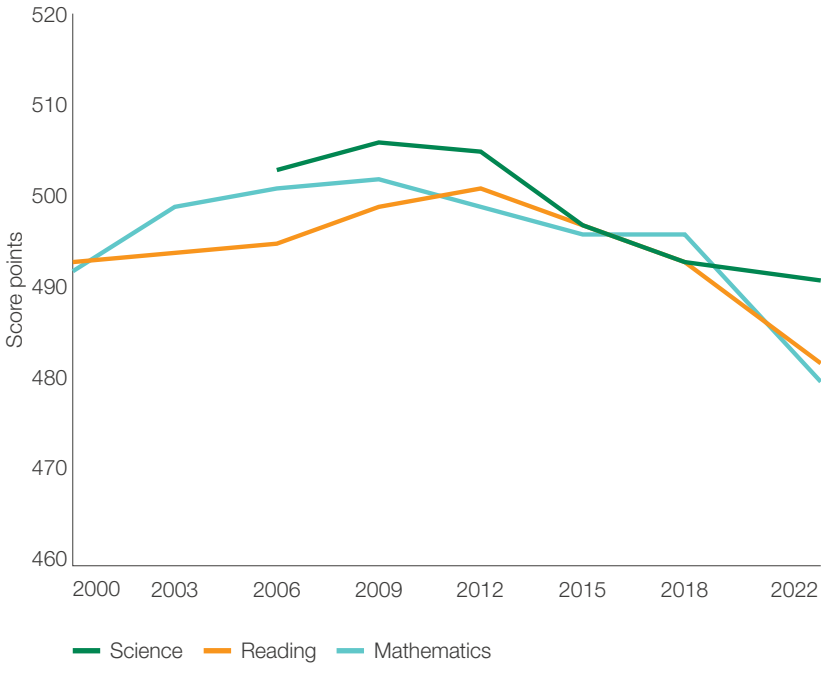
Curiosity, too, requires exercise. When learners consistently receive answers rather than working towards them, the desire to understand may itself atrophy. A generation of learners whose intellectual problems are routinely solved for them may be less equipped not only to think independently, but to want to.

These risks compound pre-existing challenges witnessed in young people: rising anxiety, difficulty concentrating, shorter attention spans and trouble learning new things, as documented by Haidt[34] and others.[35] They coincide with the rise of smartphones and algorithmically curated content. Together, these developments have reshaped how young people engage with information.

Furthermore, research on digital multitasking consistently shows links to lower academic performance, weaker comprehension and poorer self-regulation, all patterns that mirror AI-mediated cognitive offloading.[36] The two challenges are mutually reinforcing, as students habituated to task-switching are less likely to engage in the slow, difficult work that deep learning demands, and AI tools that remove that difficulty make the habituation worse.

The threat of cognitive offloading is particularly acute amid already declining learning outcomes. Even before the introduction of mass commercial AI tools (2022) the OECD's Programme for International Student Assessment (PISA) data showed substantial declines in student performance in mathematics, reading and science since the early 2010s (Figure 5).[37] Adults are not immune: the OECD's 2024 Survey of Adult Skills found literacy declining in 11 countries and falling among tertiary-educated adults in thirteen.[38] These trends reflect a complex interplay of factors, including increased smartphone use, social media, pandemic and other disruptions. Against this backdrop, AI may exacerbate existing weaknesses by reducing opportunities for active cognitive engagement rather than being the primary cause of these declines.

FIGURE 5 **Global PISA scores, 2000-2022**



Note: PISA - Programme for International Student Assessment.
Source: Organisation for Economic Co-operation and Development (OECD).

These findings reveal that even already highly educated populations are losing the competencies needed to navigate an environment of abundant information. The above patterns might reflect changes in how humans should use their brains after all. For instance, we now use our smartphones for most calculations, so we don't exercise some numerical skills as regularly. Vocabulary is also weakening, perhaps because of changes in people's reading habits.[39]

According to the Forum's Education 4.0 framework, the competencies most essential for the coming decades – complex problem-solving, analytical thinking, and creativity – depend on sustained, effortful cognition.[40] As labour markets have been shifting towards non-routine work requiring judgement, contextual reasoning and ethical intuition, these are precisely the capacities that deep learning is meant to cultivate and that AI offloading tends to suppress.[41]

This is not just a concern for individual learning but also for collective human capital formation. AI tools can support expert practitioners by extending their informational reach and reducing routine burdens. However, they may pose challenges for novices who lack the tacit knowledge to judge when the machine's output is wrong. If formative professional experiences are mediated by systems that do thinking, future practitioners may never develop the cognitive and ethical intuition their roles require. The concern, therefore, is not that AI will replace experts, but that under certain conditions it could prevent them from ever emerging.

These developments are particularly unsettling, given that "willingness to learn" now appears in nearly 20% of European online job advertisements, more than any other listed requirement.[42] Yet, learnability rests on the capacities most threatened by uncritical reliance on AI: metacognition, sustained attention and memory. Creative insight arises from spontaneous neural reorganization among concepts that are already held in the mind.[43] The brain cannot form connections between concepts that are not stored. A mind that has outsourced its knowledge base to external systems has outsourced the preconditions for original thought.

Schools do more than transmit knowledge: they train the brain to work with it. When learners consistently bypass that process, they bypass the neural consolidation that makes future learning possible.

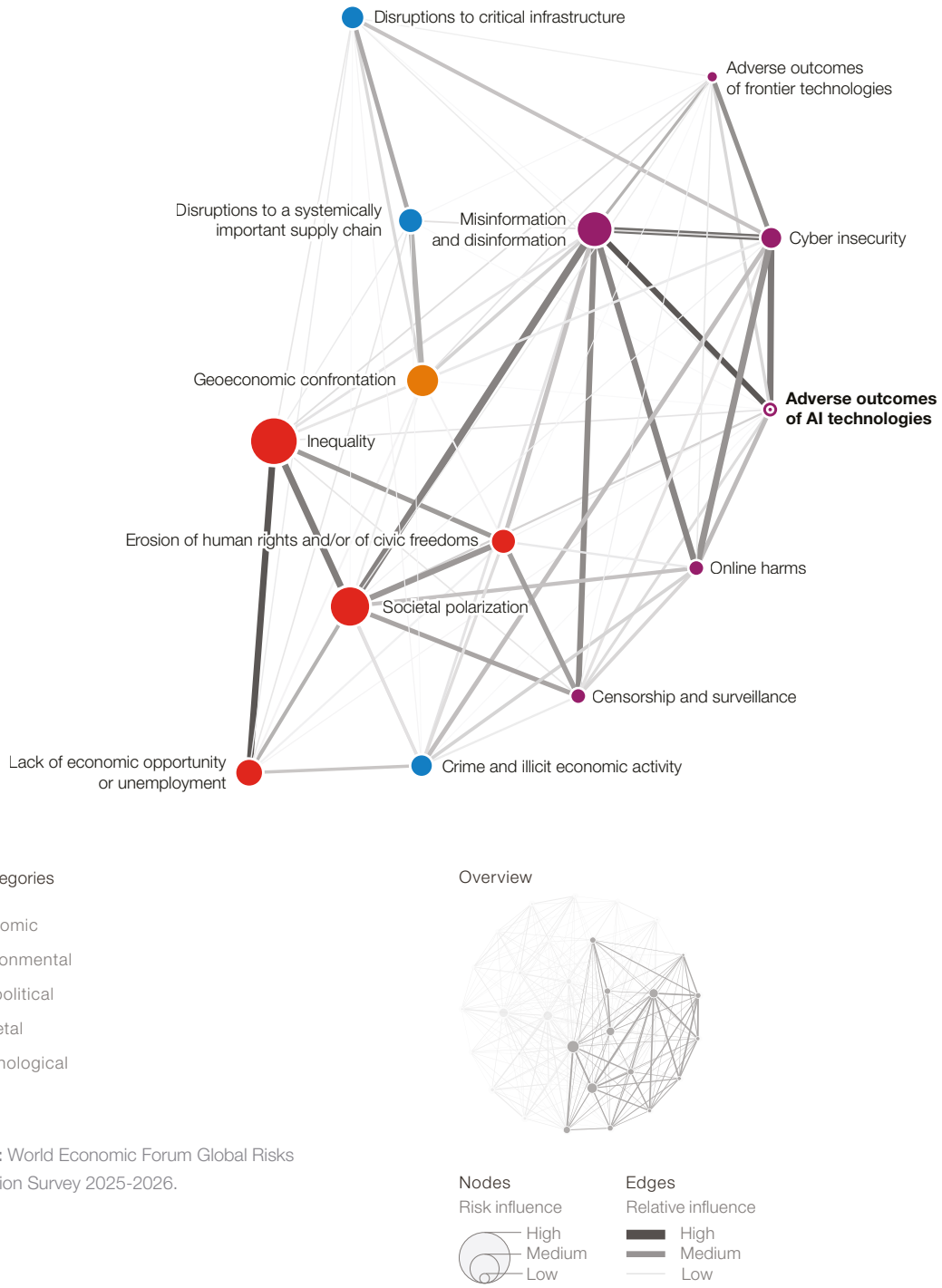
2.2 Hallucinations and misinformation

AI's generation of misinformation poses a threat to education that is qualitatively different from prior information risks because it erodes the epistemic habits that education itself is meant to build.

For the first time, information is not merely transmitted but synthesized by systems whose linguistic fluency often exceeds their factual reliability. Large language models (LLMs) generate coherent sentences from statistical patterns, sometimes without evidence, producing what researchers call hallucinations (factually incorrect or fabricated statements delivered with full rhetorical confidence).[44] The risk is not merely that inaccurate information exists, but that it arrives in a form optimized for belief, which makes this particularly concerning in the educational environment.

Even as models improve, hallucination remains a substantial risk. Recent research finds that when AI

FIGURE 6 **Global risks landscape. Adverse outcomes of AI technologies, 2026**



Source: World Economic Forum Global Risks Perception Survey 2025-2026.

models hallucinate, they tend to use more confident language than when providing information, making them 34% more likely to use phrases like "definitely," "certainly," and "without doubt" when generating incorrect information.[45]

In educational settings, learners risk internalizing a cognitive norm in which plausibility replaces truth. When a student receives a fluent, well-structured AI response, the very qualities that signal trustworthiness in human communication, such as coherence, confidence and apparent comprehensiveness, are present regardless of factual accuracy. Education exists to cultivate epistemic vigilance: the capacity to ask, 'How do I know this is true?'. Learning involves verifying sources, proving theorems and evaluating historical or scientific claims. Over-reliance on generative AI's output, especially commercial tools not adapted for learning, might invert this relationship, instead encouraging acceptance rather than inquiry.[46]

These vulnerabilities are not uniform across age groups. Primary-school children are less likely to question an authoritative-sounding source and are more susceptible to forming lasting misconceptions.[47] Older students, though more capable of evaluating AI output, may choose not to do so due to academic pressure.[48] And educators are not exempt. Teachers who use AI tools are equally exposed to hallucinated content and may propagate the inaccurate information with the added authority of their professional role.

These risks are compounded by what scholars describe as post-literacy: a condition in which basic reading and writing remain widespread, but the greater skills of interpretation, evaluation and source verification are waning.[49] Where greater evaluative skills are already in decline, the fluent, authoritative surface of AI-generated content is more likely to be accepted uncritically.

Behind AI's persuasive surface lies an opaque data infrastructure. Most LLMs draw on unverified, publicly scraped text with limited transparency into its origin, authorship or accuracy.[50] Peer-reviewed research, commercial content and social-media commentary coexist without distinction, replicating and amplifying existing biases. Policing such data at scale is an impossible task, as it is with the misinformation.[51] While misinformation can be managed, it cannot be fully eradicated, and even effective corrections often fail, as false information tends to spread more widely and persist longer than the efforts to correct it.[52] [53]

The challenge of misinformation is only predicted to grow. The 2024 and 2025 *Global Risks Reports* identify misinformation and disinformation as top short-term risks, with AI tools enabling their proliferation across video, images, voice and text and differentiation between AI- and human-generated content becoming increasingly difficult.[54] For educational institutions, the implications are direct: the informational environment in which students are learning is one in which the credibility of content is increasingly difficult to assess.

Academic institutions function as epistemic infrastructure, as they maintain the norms of evidence, citation, and peer review that distinguish validated knowledge from unverified claims. Generative AI now places this infrastructure under pressure. While AI-assisted research can unlock unprecedented benefits, there is genuine concern about whether academic institutions have the capacity to verify and assess the growing volume of research and AI-generated knowledge without compromising standards.[55]

For learners, the cumulative effect is corrosive. AI-generated citations that lead nowhere and confident falsehoods that sound authoritative undermine faith not only in digital tools but in the act of learning itself. When knowledge-validation processes appear unreliable, the motivation to engage in effortful verification weakens. Education risks devolving into what might be called performative truth: ideas accepted not because they have been examined but because they sound coherent.

2.3 Breakdown of academic integrity

AI's threat to erode the trust and credibility of merit-based credentials and genuine human effort undermines the social contract in education.

Academic integrity is no longer just about avoiding plagiarism. Increasingly, it is about being clear about what the students did themselves, what AI helped with, and whether the assignment aligns with the intended learning outcome. It now requires maintaining a transparent relationship between human effort, machine assistance and learning purpose. That relationship, however, is hard to define, police or assess. The ambiguity reflects a structural change in what it means to produce academic work. Anthropic analysis of nearly 575,000 anonymized student conversations on Claude.ai found that approximately 47% were interactions seeking answers or ready-made content with minimal cognitive engagement, including direct requests to avoid plagiarism detection.[56] When reflection is replaced by automation, education risks becoming an exercise in production rather than learning. The scale of the challenge is significant. According to Turnitin's survey, 95% of responders, which included educators, administrators and students, believe

AI is being misused in some capacity.[57] Even as plagiarism and contract cheating have always been a valid problem, AI has dramatically lowered the barrier and made it substantially harder to distinguish students' genuine output.

Beneath the immediate integrity concerns lies a more fundamental question about the value and purpose of assessment. Grades function as a social contract: institutions attest that the grade reflects genuine understanding, and the world beyond education acts on that attestation when making decisions about employment and opportunity. The objective of education is not to improve a grade but to improve the learner. If credentials misrepresent their holders, the contract breaks, both for those who genuinely developed their abilities and skills and for employers who rely on credentials to make decisions.

AI also flattens long-standing inequalities in academic support. Students who previously lacked access to private tutoring or family assistance with schoolwork now have access to always-available digital assistance. Such democratization of academic support is a genuine and significant benefit. However, it further raises dilemmas about cheating. Indeed, the same tools that erode fairness can expand opportunities. This tension is compounded by unequal AI literacy, as students who understand how to prompt, evaluate and refine AI output gain meaningful advantages in both legitimate and illegitimate uses. What constitutes integrity in one setting may constitute misconduct in another. The result is a new form of inequality in education: not a divide in access to technology, but in the ability to use it critically and responsibly.

Integrity risks also fall on the accreditor side. As AI tools are adopted for grading, feedback and personalized evaluation, algorithmic opacity and bias undermine the fairness and trust that assessment depends upon. In an AI-rich environment, transparency in assessment is not simply a procedural requirement but a critical readiness condition for maintaining trust, accountability and integrity of learning.

The use of tools that track writing patterns, predictive analytics and engagement metrics to detect inauthenticity or personalize content presents a challenge. On the one hand, they provide opportunities to ensure fairness and personalize learning; on the other, they blur boundaries between assessments and surveillance. These approaches may serve legitimate assessment purposes, but they risk fundamentally altering the educational relationship, transforming it from one built on trust and development into one premised on monitoring and suspicion. Protecting academic integrity, therefore, requires as much attention to how student data is used as to what the data reveals.

If the perception and mistrust persist that academic outputs can be simulated with AI, it could weaken public trust in education systems themselves, as misinformation has undermined trust in the media.[58] The consequence would not be democratization of opportunity but its opposite: reduced employer confidence, diminished socioeconomic mobility and weakened belief in merit-based achievement.

2.4 Erosion of human connection

AI and digital technologies risk weakening the relational foundations of learning, in part because many tools are optimized for efficiency, personalization and scale, rather than shared human experience.

Learning is not only cognitive but profoundly relational, built on trust, empathy and belonging. This includes not only social interaction but also physical embodiment. Movement, play, sport, and other forms of physical engagement are integral to learning and well-being, contributing to cognitive development, attention and emotional regulation. A child learns not from content alone but from connection – with teachers who notice them, peers who challenge them, and mentors who believe in them. Beyond distraction, the risk from digital mediation is disconnection: the gradual weakening of the social and emotional bonds that underpin effective learning.

The evidence of this disconnection is witnessed alongside the widespread adoption of AI. In 2024, the U.S. Centers for Disease Control and Prevention (CDC) reported that 40% of U.S. high school students reported persistent sadness or hopelessness (past 12 months), and only about half felt close to people at school.[59] These indicators point to underlying struggle in how education systems support engagement, belonging and well-being. The rapid integration of AI into learning risks compounding these challenges, as core elements of the educational experience are further reshaped without clear guidance or support.

Research across learning science and education supports what experienced teachers have long observed: emotional safety and relational trust are preconditions for effective learning.[60] When social connectedness declines, drops in attention, motivation and resilience often follow. The developmental stakes are highest in early childhood, when the brain forms more than a million neural connections per second, most of them shaped through responsive human interaction. Eye contact, tone of voice, shared attention, and

emotional attunement are not sentimental extras – they are the biological foundations of learning.[61] The importance of relationships does not diminish as children grow. Collaborative dialogue, group problem-solving and peer feedback are among the strong drivers of comprehension and long-term retention.[62] The strength of relationships between students, teachers, mentors and caregivers is a strong predictor of engagement and educational success.[63] While information technologies have improved the efficiency of content delivery, the social dimension of learning is difficult to automate even as AI and social media platforms increasingly simulate companionship.

The spread of AI chatbots, for example, introduces a new dimension to the challenge by changing how learners seek support and social connection through digital tools. For some users, particularly those experiencing loneliness or social anxiety, AI companions may serve a genuinely beneficial role.[64] Yet sustained reliance on simulated relationships risks blurring the distinction between authentic connection and its imitation at precisely the developmental stage when the ability to form real relationships is being built.

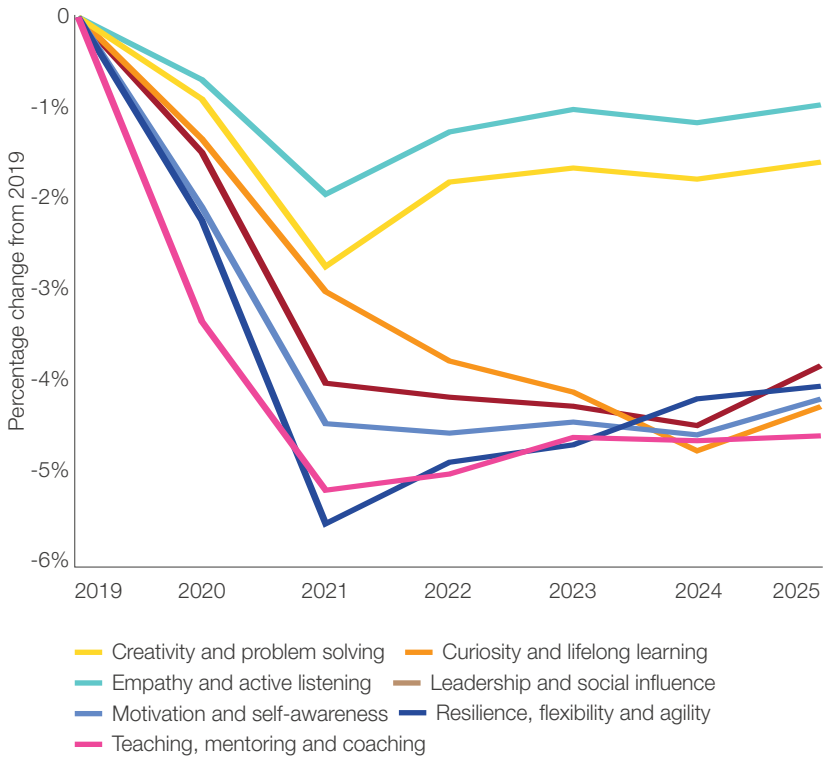
This shift becomes concerning when learners begin seeking to "offload" empathy, attentiveness and emotional regulation to machines rather than practising these skills themselves. A growing reliance on AI in this way may also signal a shift in trust, with some students placing greater confidence in machines than in human relationships. Students who find it easier to process emotions with AI than with peers, parents or teachers may struggle to transfer these skills to offline contexts, reinforcing patterns of social offloading in which care, empathy and attentiveness are increasingly delegated to technology.

The capacity to connect meaningfully with others, to listen, pay attention, collaborate, and care will matter even more in the future of learning. The Education 4.0 framework emphasises that technology should enhance, not replace, the interpersonal dimension of learning.[65] The erosion of human connection in learning environments also reflects broader societal and labour-market shifts. As AI and automation take on an expanding range of cognitive and routine tasks, the value of distinctly human capabilities continues to grow.

The World Economic Forum's *Future of Jobs Report 2025* identified that human-centric skills such as resilience, flexibility, empathy and active listening to be among the most sought-after capabilities in future labour markets.[66] Yet, in practice, these capacities are surprisingly fragile and highly sensitive to external shocks. A World Economic Forum analysis reports that these capacities declined during COVID-19, when opportunities for practice, collaboration and feedback diminished, and that by 2025, no human-centric skill had returned to pre-2019 levels (Figure 7).[67]

If these relational capacities decline at scale, the consequences extend beyond education. Civic life, workplace cohesion, democratic participation and social trust all depend on the ability to collaborate across differences, to listen with genuine attention, and to care about outcomes beyond one's own. In a world where those interactions are increasingly mediated or replaced by digital and AI systems, they must now be intentionally preserved and built into the new architecture of learning, not assumed to arise from it.

FIGURE 7 **Self-reported skills trends, 2019–2025**



Source: BetterUp; World Economic Forum, Global Skills Taxonomy.

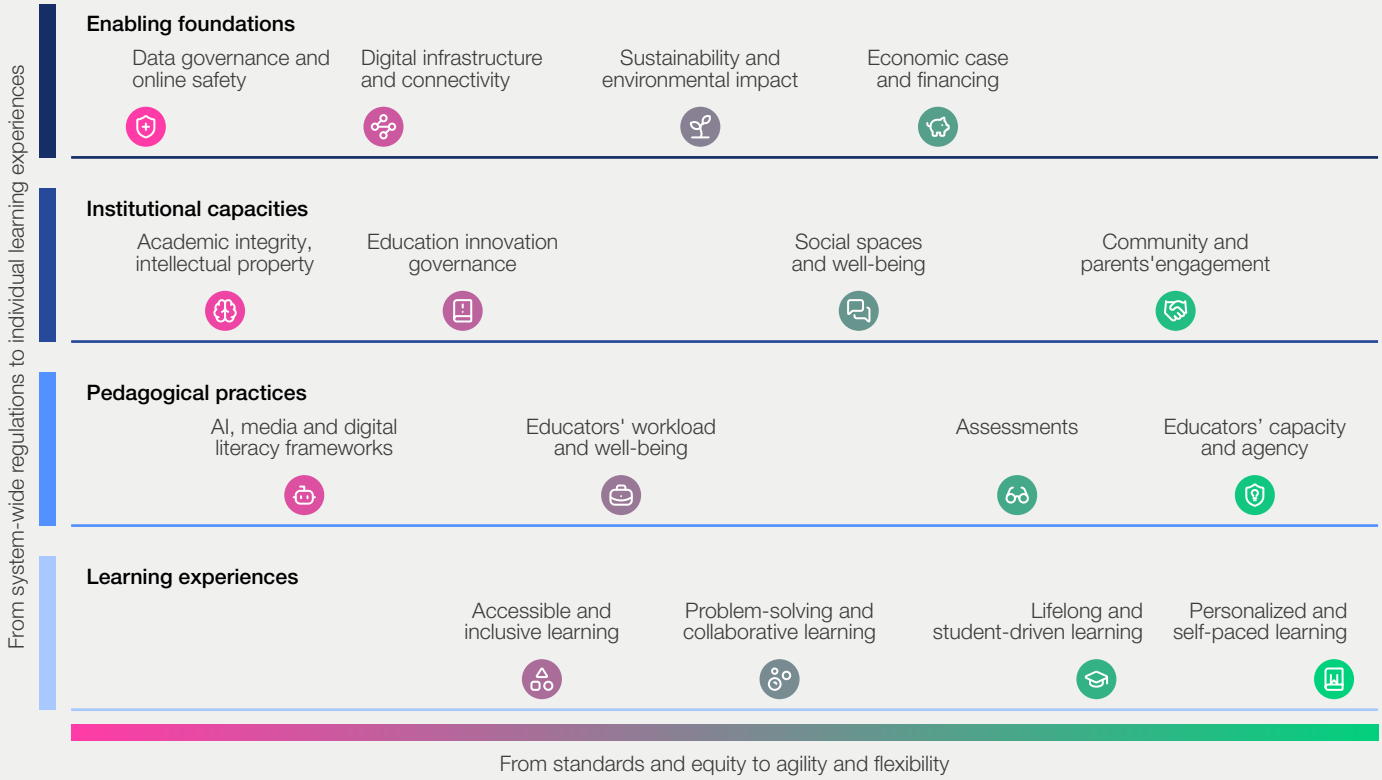
3 Building education readiness for the age of AI

3.1 AI readiness framework for education

Current responses to AI in education remain fragmented. Policy efforts focus on regulation and infrastructure, pedagogical approaches centre on classroom practice, and technological solutions emphasise tools and platforms. While each of these interventions is important, none is sufficient on its own. Education outcomes are produced through interactions across multiple levels of the system, while responsibility for those outcomes is distributed across actors.

The proposed framework (Figure 8) is designed to organize and coordinate such a collective response. Its objective is to identify changes that can be undertaken today and focus not on disruptive solutions but on strengthening the foundations upon which education can be strengthened.

FIGURE 8 **Education system readiness framework for AI integration (condensed)**



Source: World Economic Forum.

3.2 Principles of the framework design

The framework identifies the conditions required for education systems to adopt AI in ways that strengthen learning, protect equity, maintain institutional trust and support human development. It is organized around four interconnected dimensions – enabling foundations, institutional capacities, pedagogical practices and learning experiences – each of which is necessary but none of which is sufficient alone.

Aligning across levels

The four dimensions are arranged vertically to reflect different levels of the education system, from broad enabling foundations to the concrete learner experiences. Moving from top to bottom, the framework progresses from factors that shape the overall system environment, to institutional capacity, to teaching practice, and finally to the conditions under which learners engage with and benefit from AI.

Enabling foundations refers to the external conditions that shape how AI is integrated across wider learning systems. As education increasingly takes place in digital and AI-enabled environments, responsibility for shaping these conditions extends beyond formal academic institutions to the broader ecosystem of platforms and technologies that were not originally designed for education but are now influential in shaping how learners' access and engage with information. These conditions determine whether AI adoption is viable, equitable, financially sustainable and environmentally responsible at scale.

Institutional capacities reflect the ability of schools, universities and training providers to operationalize AI in ways that enhance learning while protecting integrity, well-being and trust. This means governing academic integrity and intellectual property, creating safe conditions for educational innovation with human oversight and ethical guardrails, protecting the social and physical spaces that support connection and well-being, and engaging families and communities as genuine partners in responsible AI use.

Pedagogical practices concern the conditions under which educators can exercise informed professional judgement in integrating AI into learning. While AI can enhance access to content and streamline instructional tasks, effective teaching requires contextual understanding, relational skill and the capacity to determine when AI supports learning and when it does not. This depends on investment in educator capacity, workload management, fit-for-purpose assessments, and robust AI and digital literacy frameworks.

Learning experiences focus on the capabilities and conditions that enable learners to benefit from AI-enhanced learning while mitigating associated risks. These learning experiences were first developed in 2020 as part of the Education 4.0 framework and since their publication, these pedagogies have seen significant uptake. Unlocking learning readiness requires continuous effort to strengthen inclusive and accessible design, collaborative and problem-solving approaches, personalized and self-paced pathways, and systems that support lifelong, student-driven development. Together, these conditions prepare learners to be active, ethical and cognitively resilient users of AI, benefiting from personalization and rapid feedback while still developing the deeper capabilities that AI cannot replace.

Balancing standards and equity with autonomy and agility

Across all four dimensions, the framework reflects a second organizing principle: the need to balance standards and equity with autonomy and agility.

At one end are conditions that prioritize consistency, safety and fairness. These include clear rules, shared standards and strong safeguards; for example, data governance, online safety and equitable access to infrastructure. These are essential for building trust and ensuring that all learners are protected and supported equally.

At the other end are conditions that prioritize flexibility, responsiveness and innovation. These include approaches that enable educators and learners to adapt to context, such as personalized learning pathways, student agency, and the integration of emerging technologies into teaching and learning. These allow systems to respond to diverse needs and a rapidly changing environment.

This is not a fixed division, but a continuum that cuts across all dimensions. In general, system-level conditions tend to require greater standardization, while conditions closer to teaching and learning allow for greater flexibility. Importantly, these two imperatives are interdependent: strong standards in areas such as governance and safety lay the foundation for greater autonomy elsewhere.

The framework invites leaders to reflect on whether this balance is appropriate within their context, as excessive rigidity may stifle innovation and unchecked autonomy may undermine equity and trust. The aim is not to prioritize one over the other, but to manage this balance deliberately across different parts of the system. By exploring each category through this lens, the framework serves not only as a diagnostic tool but as a strategic guide for developing education systems that are simultaneously equitable and future-ready.

3.3 Application of the framework

The significance of this study lies in its effort to move the conversation beyond polarized debates about whether AI will strengthen or weaken education. We have a significant opportunity to harness technology to unlock substantial value for learners. Doing so requires a shared understanding of the challenges and opportunities ahead, as well as a common framework for action. The framework can serve as a starting point for such collaborative action and practical implementation across global, national and institutional contexts. In practice, these applications are most effective when undertaken through structured dialogue across stakeholders. Policy-makers, institutional leaders educators and other actors can use the framework together to assess current conditions, identify gaps and align priorities, ensuring that actions taken at one level of the system are informed by and coordinated with others by:

- Conducting system-level or institutional readiness assessments.
- Identifying priority gaps across 16 categories.
- Aligning policy, funding and capacity-building efforts with the most critical readiness needs.
- Supporting pilot initiatives to test and refine AI integration approaches.
- Establishing mechanisms for monitoring progress over time.

While the evidence base on AI in education continues to evolve, the readiness conditions apply across various scenarios of technological development. Below, we suggest questions that five key stakeholder groups might ask one another, using the framework's signals, to guide practical action. The suggested questions are most powerful when used across groups in structured dialogue – for example, in school-level working groups, national policy reviews or multistakeholder forums convened around a specific readiness dimension.

Used this way, the framework becomes a coordination tool: a shared language that connects the systemic conditions a ministry controls, the institutional choices a school makes, the pedagogical judgements a teacher exercises and the learning habits a student develops.

Education officials and policy-makers

The framework offers a diagnostic structure for identifying where policy is ahead of practice and where critical gaps remain.

- Do we have enforceable data and privacy protections designed specifically for children in AI-enabled learning environments, or are we relying on general frameworks that were not designed for this purpose?
- What independent, publicly available evidence are we using to evaluate whether current EdTech investments are improving learning outcomes, and do we understand the full cost of ownership?
- Are we establishing the conditions for safe innovation through sandboxes, procurement standards and accreditation protocols, or are technologies reaching classrooms without systematic evaluation?

School administrators and institutional leaders

Institutional leaders must translate system-level policy into operational reality. The framework provides a structured basis for leadership conversations about where their institution stands and where it may be exposed.

- Do we have a clear, well-communicated and enforceable policy on acceptable AI use that staff, students and parents understand, and are we updating it as the technology evolves?
- Are we actively protecting physical spaces, allocated time and structured opportunities for social interaction and collaborative learning, or allowing them to erode?
- Are we engaging families as genuine partners in decisions about technology use, data governance and student well-being, or informing them only after decisions have been made?

Teachers and educators

Teachers serve as the critical translation layer between policy and learning. The framework supports their professional judgement by clarifying the pedagogical conditions under which AI supports learning and where it may hinder it.

- When should I encourage students to use AI as a tool, and when should I insist they work through the task themselves? Am I equipped to make that judgment confidently?
- How can I redesign assessments to capture reasoning, reflection and genuine understanding rather than outputs that AI could easily produce?
- Am I receiving the professional development, time and institutional support necessary to integrate AI thoughtfully, or am I expected to navigate this transition on top of an already demanding workload?

Parents and caregivers

Parents hold a direct and enduring stake in their child's education. The framework gives families concrete language to move from general anxiety about AI to specific, productive questions.

- Is my child using AI transparently, and do I have meaningful channels to understand what tools are being used, what data is being collected, and how my child's academic performance is being affected?
- Is my child developing the skills, habits and relationships that learning is meant to build, or producing AI-assisted outputs that resemble learning but bypass the process?
- How can I establish informed boundaries at home around AI use, and where can I access guidance to support my child's responsible engagement with these tools?

Students and learners

Students are active participants whose choices shape their own development. The framework's learner-readiness signals directly address this agency.

- Am I building capabilities that will matter beyond the classroom (reasoning, collaboration, persistence) or am I taking shortcuts that feel productive now but weaken my capacity over time?
- Do I understand the difference between AI helping me learn and AI doing the learning for me, and am I honest with myself about which is happening?
- Am I maintaining real relationships, seeking out genuine collaboration, and practising the social and emotional skills that no technology can develop for me?

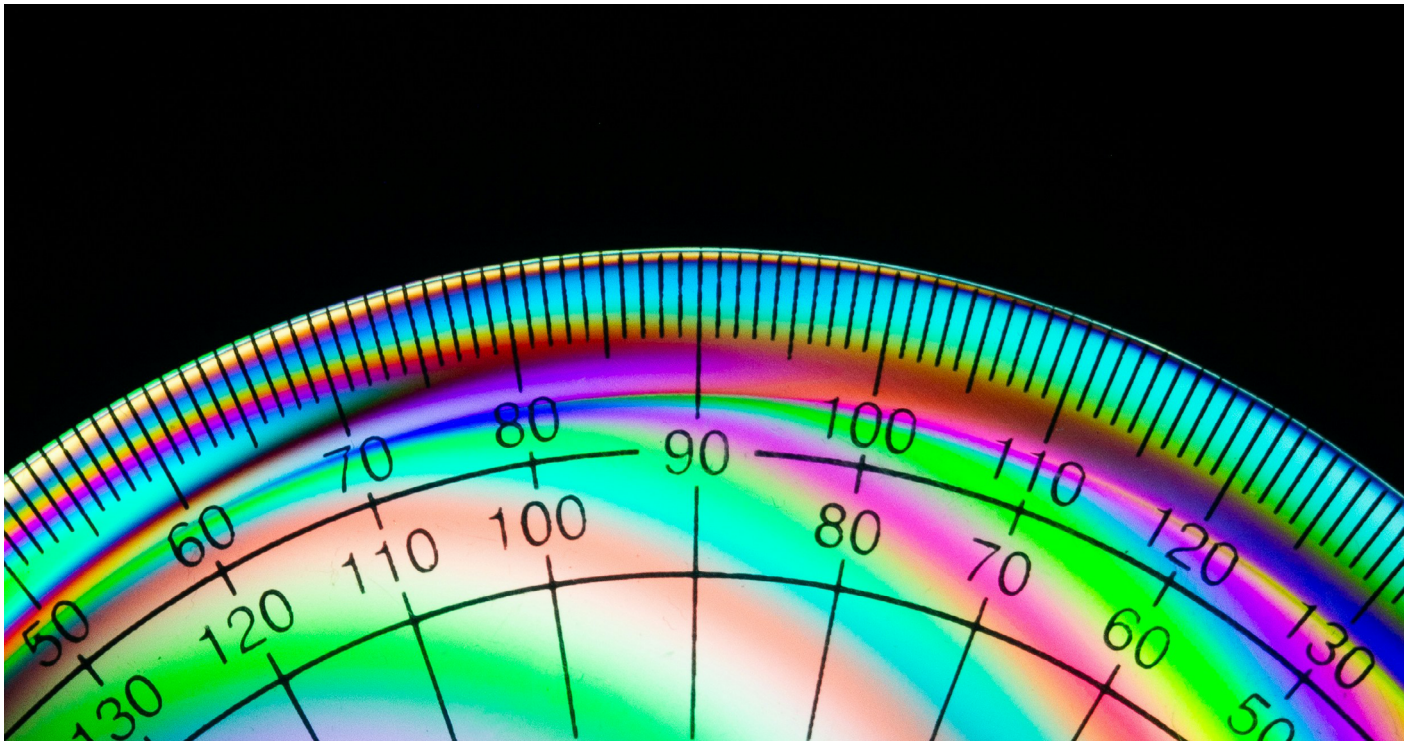
The pace of technological change means that the balance between standards and autonomy, between efficiency and human connection, will require continuous recalibration. The same structural gap that motivated this framework – between the pace of AI development and the pace at which institutions can thoughtfully respond – is not a problem to be solved once. It is a condition to be actively managed. The framework's signals are designed to support that ongoing process, not as a fixed audit, but as a living reference for the conversations that keep education systems genuinely ready.

4 Signals of readiness for AI in education

The framework's central proposition is that outcomes depend on alignment across these dimensions: system-level governance that does not translate into institutional practice will remain aspirational; institutional policies without pedagogical support will not reach the classroom; and pedagogical innovation without attention to learner readiness will not produce durable learning. Each dimension is underpinned by readiness signals that highlight priority areas for investment, reform and cross-stakeholder collaboration.

The framework does not prescribe a single model of AI integration, rank systems against one another, or assume that any education context starts from the same baseline. Its value lies less in any individual signal than in the holistic approach to manage risks and leverage opportunities of AI in education. A ministry of education depends on institutional and pedagogical conditions it may not directly control and schools depend on system-level infrastructure and policy that they cannot create alone. This interdependence is not a flaw, it is the framework's core insight.

While the signals are not designed as a formal scoring system, many can be translated into observable or measurable indicators. Systems may assess the presence of national AI guidelines, levels of educator training, access to digital infrastructure or the extent to which AI-related competencies are embedded in curricula.



ENABLING FOUNDATIONS

Data governance and online safety

Is there robust, transparent and enforceable data and AI governance that protects learner privacy, mitigates algorithmic bias, safeguards cybersecurity and ensures accountability for the use of AI in education?

Rationale

Learning increasingly happens in digital and virtual spaces that extend beyond the boundaries of formal education systems, such as platforms, tools and environments that academic institutions neither own nor fully control. This shift raises a fundamental question: are learners safe in these environments?

Ensuring safety demands enforceable guardrails that protect learners' identities, privacy, and data. This includes clear protocols for responsible data use, transparent consent systems with specific safeguards for children, and strict governance over who can access, process and store learner information. According to the World Economic Forum's Global Coalition for Digital Safety, no single intervention can address the myriad forms of online harm. Addressing them requires a multifaceted approach spanning technical, educational, policy and behavioural dimensions capable of evolving in tandem with threats they are designed to mitigate and not just react once the harm is done.[68]

However, in an educational setting, a structural tension persists since academic institutions remain accountable for learner protection, even if they often lack full visibility and control over third-party technologies and AI systems. This also raises questions of AI sovereignty, ensuring that education systems retain meaningful control over learner data, digital infrastructure and AI.

Cybersecurity resilience is essential to build trust on which effective learning depends. When learners, educators and families trust that data is handled with integrity and that learners are safe online, this not only mitigates risks but also opens the door to safe and ethical learning, personalization, assessments and the scaling of educational innovations.

Signals

Transparent data and AI governance: Adopted and enforced national frameworks that define how learner data is collected, stored, accessed and used. These frameworks include mechanisms for auditing, accountability, and oversight of AI systems, including third-party providers.

Child-specific privacy and safety protections: Legal and regulatory safeguards ensuring age-appropriate consent, data minimization and protection from algorithmic bias. They also restrict inappropriate data exploitation and establish enforceable standards for safe content and interactions in AI-enabled educational environments.

Cybersecurity and risk oversight capacity: System-level protocols and monitoring mechanisms to identify, monitor, audit and respond to risks across digital and AI-enabled learning environments.

Digital infrastructure and connectivity

Are the digital infrastructure and connectivity across the education system resilient, equitable and secure enough to ensure reliable access, interoperability and the operational capacity to maintain and upgrade them over time?

Rationale

AI-enabled learning depends on stable, secure and equitable digital infrastructure. Connectivity, computing capacity, power reliability and interoperability platforms form the foundation upon which digital learning systems operate.

However, infrastructure alone does not guarantee meaningful participation. Effective readiness depends not only on provision, but on the system's ability to maintain, monitor and adapt infrastructure over time. Without continuous oversight of access gaps, sustainable financing models and long-term upgrade strategies, digital expansion risks entrenching existing inequalities. As AI adoption increases demands on data storage, processing power, energy consumption and platform integration, infrastructure must be treated as a strategic priority. Effective digital infrastructure is the foundation that enables every learner and educator to benefit from technological innovation.

Signals

Availability of reliable connectivity and access: Provision of reliable broadband, device access and power with defined minimum connectivity standards.

Affordability and equity: Monitoring access across regions, income groups and demographics informs targeted, adaptive investment policies to close infrastructure gaps.

Interoperability and maintenance: Principles of open standards, vendor neutrality and data exchange, supported by routine monitoring, planned upgrade cycles to maintain long-term performance and resilience.

Sustainability and environmental impact

Is the environmental footprint of AI-enabled education across energy use, device life cycle and procurement actively accounted for and embedded as a condition of responsible adoption?

Rationale

Education systems can be large and structurally influential adopters of new technologies. Decisions made across schools, districts and systems about which platforms to deploy, how to store the data, which devices to procure and how to manage infrastructure carry environmental consequences at scale.

AI usage carries real and growing environmental costs that must be understood, managed and transparently reported. Emerging evidence shows that machine-learning models used in educational platforms vary significantly in energy consumption, depending on model complexity, algorithmic design and deployment hardware.[69] This creates a clear responsibility to consider standards for energy-efficient deployment and requires transparency around energy use and carbon footprint. Effective sustainability, however, goes beyond measurement; it depends on the system's capacity to make informed trade-offs between local, cloud or hybrid data usage and storage. These decisions can often be shaped by external providers, creating dependencies that can limit visibility into the true environmental footprint of AI systems.

A viable alternative to large language models (LLMs), small language models (SLMs) might be more efficient, as these models can often run locally, reduce energy consumption and improve data privacy, making them a potentially more sustainable option in many educational contexts.

Furthermore, accessing digital opportunities requires widespread device adoption, generating increasing e-waste as devices are frequently replaced without adequate repair, reuse or recycling systems. Without clear policies and operational capacity for repair, reuse and safe disposal, digital expansion risks shifting environmental costs.

As AI integration in education is still at a relatively early stage, its environmental and energy demands are likely to increase significantly as adoption scales. This creates a critical window for action: these costs must be acknowledged upfront and factored into decision-making before large-scale deployment. Early choices about infrastructure, procurement and use will shape long-term environmental impact, making it essential to prioritize sustainability from the outset to enable responsible adoption.

Signals

Energy use accountability and transparency: Measuring and reporting of information and communication technology (ICT)-related energy consumption, including carbon footprint and guidance on ecologically responsible deployment in education.

Device life cycle responsibility and e-waste management: Policies governing responsible device procurement, repair, reuse and end-of-life disposal of devices with measurable targets for reducing e-waste.

Sustainable and responsible procurement: Procurement frameworks incorporate environmental and ethical criteria, including energy efficiency, durability, reparability and green AI considerations, and are applied consistently across the technology section and approval processes.

Economic case and financing

Is the case for investing in digital and AI-enabled education grounded in transparent, evidence-based evaluation of costs, benefits and trade-offs, and supported by innovative financing models and procurement standards?

Rationale

Education systems face a fundamental question: when is the use of AI truly worth it? Not every learning task requires the most advanced technology, and indiscriminate adoption risks diverting scarce resources from more effective interventions.

At a time of constrained education budgets, deploying resources on digital innovations that fail to demonstrably improve learning outcomes is a costly mistake, not just financially. The economic case for AI in education must therefore be built on transparent cost structures, honest evidence of impact, and careful consideration of trade-offs, including teacher time, workload implications and long-term maintenance. This requires moving beyond upfront costs to fully understanding the total cost of ownership, including hardware, software, integration, cybersecurity, training, maintenance and eventual replacement or decommissioning. Furthermore, given the concentration of AI technology within a small number of innovators, education systems must also innovate in how they finance access to it. Fair licensing, non-profit access pathways and predictable funding models are essential to ensuring that educational innovation is not determined solely by commercial interests.

When investment decisions are grounded in credible evidence, full costs are understood, and financing models promote equitable access as a public good rather than a purely commercial transaction, education systems can adopt AI with confidence, knowing that every resource spent serves learning.

Signals

Cost-benefit evaluation: Ability to access investments based on independent and publicly available evidence of impact on learning outcomes and educator workload, including the full cost of integrating new technologies into the learning process.

Funding models: Sustainable, equitably distributed financing for education technology is ensured through diverse funding models governed by clear regulatory oversight and long-term budget planning.

Procurement and fiscal responsibility: Standards and accountability mechanisms to govern public spending in education, ensuring full cost transparency, vendor neutrality and subordinating commercial relationships to education outcomes.

INSTITUTIONAL CAPACITIES

Academic integrity, intellectual property

Are there clear institutional standards for authorship, originality and intellectual property, and robust safeguards against plagiarism and the misuse of synthetic media in education?

Rationale

A profound shift is underway as AI enables users (both teachers and students) to become creators, raising important questions about quality, validation and accountability.

AI is rewriting the rules of authorship. When learners submit work co-created with AI, or educators develop materials using AI-generated content, existing assumptions about ownership, originality and academic credit no longer fully apply. Without clear and enforceable approaches, institutions risk undermining the credibility of their qualifications, not through malice but through ambiguity.

What makes this challenge particularly urgent is a deeper shift: AI tools are enabling both students and teachers to move from being consumers of knowledge to creators of content. This evolution brings many opportunities for creativity, personalization and productivity but it also raises fundamental questions about quality, validation, accountability and intellectual ownership.

Intellectual property frameworks designed for a pre-AI context are struggling to keep pace with synthetic media and AI-assisted creation. Institutions have a responsibility to get ahead of this by establishing clear policies on authorship standards, updated IP governance in learning and research, and the ethical boundaries of AI assistance. Done well, this does not stifle the use of AI in learning; it provides trust and legitimacy.

Clear rules give educators and learners the confidence to engage with AI tools openly and constructively, while preserving the integrity and trustworthiness that make credentials meaningful.

Signals

Academic authorship: Institutions establish, communicate and enforce clear expectations on acceptable AI use, including citation, disclosure and the use of synthetic media by both learners and educators.

Intellectual property regulation: Defined and applied principles for ownership and use of AI-assisted and AI-generated content across teaching, learning, and research.

Credential standards: Clear standards for authorship and originality in qualifications, assessments and published output, including requirements for AI-assisted work.

Anticipation mechanism: A formal institutional mechanism to monitor developments in AI tools, IP law, and academic integrity risks, and regularly updated policies in response.

Education innovation governance

Does the education system have the governance structures to enable safe and ethical experimentation with AI and emerging technologies?

Rationale

The only way to determine whether educational innovation improves learning is to pilot, test and adapt it in real conditions. A future-ready education system, therefore, needs an ecosystem where innovators, researchers and educators can experiment safely without exposing learners to harm — and where failure generates evidence rather than risk.

This requires robust governance structures that actively shape how innovation is introduced and scaled through clear and open standards, age-appropriate design, and content assurance mechanisms. These ensure that only solutions that meet defined safety, efficacy and ethical design standards reach learners.

Strong and transparent governance is not the enemy of innovation; it is what makes it trustworthy.

Signals

Innovation sandboxes: Structured pilot environments and appropriate space for innovation to allow new educational technologies to be tested, iterated and evaluated safely before system-wide rollout.

Accreditation and impact-evaluation protocols: Processes for assessing EdTech innovations and AI tools prior to adoption according to data protection and safety standards, with integrated feedback mechanisms from educators.

Active EdTech industry associations: Recognized industry bodies setting and enforcing industry standards for transparency, data ethics and evidence of learning impact, creating accountability within the market alongside regulatory standards.

Social spaces and well-being

Are learners supported by safe, inclusive and accessible physical spaces for social interaction and play, alongside consistent well-being monitoring and accessible social, emotional and psychological care?

Rationale

Humans are inherently social, and a significant part of what education does cannot be digitalized. As more learning moves online, there is a risk that physical spaces, and the interactions that occur there, are treated as optional. They are not. Schools function as civic anchors where young people develop empathy, social capital and the interpersonal capabilities that shape long-term well-being, employability and civic participation.

Evidence consistently shows that physical human connection is foundational to healthy brain development, making relational trust, belonging and collaboration structural requirements of any education system.[70] Even when AI delivers content efficiently and at scale, learners still need physical spaces to connect, collaborate and learn from one another.

Protecting and prioritizing these spaces while actively monitoring learner presence, engagement and well-being ensures that AI adoption enriches education rather than narrowing it to content delivery alone.

Signals

Availability of inclusive physical spaces: Preservation of safe, inclusive environments that support in-person interaction, play and sport alongside digital learning environments.

Allocated time for social learning: Dedicated time for social interaction, collaboration and play formally embedded within school routines, timetables and activities.

Well-being monitoring: Regular measurement of attendance, engagement and social connectedness, with absenteeism being tracked as a key early-warning indicator.

Accessible support services: Counselling, socio-emotional, and mental health services are available as part of ongoing support, not only in crisis situations.

Community and parents' engagement

Are schools, families and local communities actively engaged as partners sharing responsibility for learners and contributing to governance, digital safety and oversight?

Rationale

Parents and caregivers have a direct and enduring stake in a child's education. Systems that treat families as passive recipients of decisions overlook a critical source of support, accountability and trust. Effective readiness, therefore, depends on continuous engagement that enables families to participate in school governance, understand how technologies are used, and support responsible digital practices at home. While schools play a critical role, parents and caregivers are equally central in shaping how learners engage with digital tools, particularly outside formal learning environments.

Beyond the family unit, schools sit within wider communities, connected to employers, cultural institutions and civil society. Partnerships with these actors strengthen the relevance of learning, continuity and equity. Education systems that bring families and communities along will adapt faster, earn greater trust and ensure that the benefits of AI in education are more equitably spread.

Signals

Structured parental participation: Clear channels for parents and caregivers to access information on student performance, provide feedback, participate in school and student data governance, and contribute to decisions on technology use and safeguards.

Parent education and awareness: Availability of knowledge and tools for parents to understand AI use in education, navigate digital environments and actively support their children's learning and well-being at home.

Community, employer and career partnerships: Active relationships with employers, industry, civil society and cultural organizations to provide learners with visibility into career pathways, real-world opportunities and labour-market expectations, alongside career education and counselling, for learners and caregivers.

PEDAGOGIGAL PRACTICES

AI, media and digital literacies

Are AI, media and digital literacies embedded as foundational competencies across curriculum, teacher development, instructional design and student learning outcomes?

Rationale

If basic literacy – the ability to read and write – has long been the foundation of education, AI and digital literacies are now essential extensions. Without them, learners cannot effectively navigate information environments shaped by generative AI and content oversaturation.

New literacy frameworks are necessary to equip both educators and learners to identify algorithmic bias, counter misinformation and resist over-reliance on automated outputs – capacities that are increasingly fundamental to immediate academic integrity and long-term civic participation. Beyond mitigating risks, these competencies enable learners to engage productively with AI tools, benefit from personalized learning and be more competitive in future labour markets. Education systems that treat these literacies as foundational will develop learners who are not just consumers of AI, but confident, critical participants.

Signals

Availability of literacy frameworks: Education systems establish and apply AI, media and digital literacy frameworks as foundational competencies for learners and educators, with clear guidance for classroom practice.

Cross-curricular integration and educator support: AI, media and digital literacy are integrated across subjects and disciplines, supported by dedicated teacher training, curriculum guidance and community-facing learning programmes.

Systematic measurement of digital fluency: Systems assess and track AI, media and digital competencies for both learners and educators through national, regional or institutional evaluations.

Educators' workload and well-being

Are educator workload, job satisfaction and well-being continuously monitored with findings actively informing the rationale for adoption of tools that reduce administrative burden and improve pedagogical efficiency?

Rationale

AI is arriving in classrooms without being necessarily requested by teachers. Nevertheless, educators are expected to navigate, evaluate and integrate new technologies into their practices, often without adequate support or preparation, and on top of already demanding workloads. Before education systems can realize the benefits of AI, they must understand how their educators are experiencing this transition.

Systematic monitoring of workload, job satisfaction and well-being provides the insight needed to support meaningful adoption rather than reluctant compliance. When teachers are supported and their workload is managed, responsible automation can deliver on its promise, freeing time for the relational, creative and cognitive dimensions of teaching that cannot be replaced by AI. Without this foundation, even well-designed tools will be resisted, misused or abandoned. Education systems that invest in understanding and supporting their educators create the conditions for innovation to take root.

Signals

Administrative workload and task allocation: Institutions monitor and review time spent on administrative and non-pedagogical tasks, identifying opportunities to streamline processes and reduce unnecessary burden.

Workload, well-being and tenure monitoring: Systems regularly track educator workload, job satisfaction, stress levels and retention rates as indicators of educator well-being and organizational health.

Educator support: Institutions provide accessibly pedagogical support infrastructure spanning technical assistance, peer exchange and mental health.

Assessments

Are assessment methods reliable, fit for purpose and aligned with pedagogical aims, and do they incorporate digital and AI-enabled approaches where appropriate?

Rationale

AI in education is increasingly associated with improvements in student performance. However, the purpose of education is not simply to improve grades but to support the learner's development.

Many traditional assessment methods were not designed for a context in which information is instantly accessible, and AI can generate well-structured responses in seconds. As a result, approaches that focus primarily on recall or final outputs are becoming less effective proxies for genuine learning.

At the same time, while the importance of rote memorization may decline, the process of mastering knowledge continues to develop broader capabilities, such as grit, curiosity, communication and critical thinking. Assessment must therefore evolve to capture these abilities, skills, attitudes and values, in line with the Education 4.0 taxonomy.[71]

Future-ready education systems must therefore redesign assessment to focus on meaningful evidence of learning, including reasoning, reflection and the ability to work effectively with AI, while also recognizing the human skills, attitudes and values that underpin long-term success.

Signals

Demonstrated understanding: Assessments that prioritize reasoning, reflection and iteration beyond formats that rely primarily on recall or final outputs.

Transparent assisted performance: Assessment policies define permissible use of AI and require appropriate disclosure while evaluating learners' ability to use AI effectively and responsibly.

Accountable evaluation process: Clear frameworks to govern how assessments are conducted, covering disclosure of AI tools used in evaluation, prevention of automation bias, identity verification, and accessible appeals protocols.

Skills credentialing: Methods to assess and capture broader skills, attitudes and values beyond disciplinary knowledge, aligned with qualification frameworks and recognized by employers and academic institutions.

Educators' capacity and agency

Do educators have the autonomy, skills and tools to design and deliver high-quality learning, with their professional judgment protected?

Rationale

At the core of effective teaching is something no algorithm can replicate yet: the ability to motivate, encourage, recognize, build trust and connect with learners in ways that unlock their potential. These relational capacities are not soft additions to the role – they are fundamental conditions for learning.

Safeguarding professional judgment ensures teachers remain the primary interpreters of learner needs, an essential defence against cognitive shortcuts and the erosion of meaningful human connection. Teachers also require space to adapt, co-design and critically engage with AI-enabled tools so that technology reinforces rather than replaces sound pedagogy.

This requires professional development that goes beyond tool-based training toward cultivating an innovation mindset, empowering educators to experiment, iterate and integrate AI in ways that deepen learning. When educators are trusted, equipped and included in decision-making, AI becomes an amplifier of great teaching rather than a substitute for it.

Signals

Protected professional autonomy: Policies and institutional practices safeguard educators' judgment in AI-assisted and data-informed decisions, ensuring teachers retain authority over pedagogical choices, tool selection, and assessment strategies.

Professional development: Educators have access to ongoing, relevant training and support necessary-to-use emerging technologies and build genuine professional capacity.

Educators' representation: Teachers and their unions hold formal, meaningful representation in bodies shaping AI adoption, curriculum design and digital learning policy.

LEARNING EXPERIENCES

Accessible and inclusive learning

Is universal access to high-quality education supported by adaptable materials, technologies and learning environments that accommodate diverse needs, languages and abilities?

Rationale

AI holds significant promise for advancing inclusion through personalised support, richer feedback, adaptive interfaces and multilingual content. However, this potential can only be realized if access itself is universal. Today, hundreds of millions of primary- and secondary-age children remain out of school, while many others face barriers related to language, disability or cultural relevance.

Without deliberate design, AI risks deepening these inequalities by concentrating benefits among already advantaged learners. Ensuring that learning tools meet universal design and accessibility standards, that content is localized and culturally relevant, and that equity gaps are actively monitored is therefore foundational to AI-enabled education.

When implemented effectively, accessibility and inclusion allow AI to broaden opportunity and strengthen the social fabric of education rather than deepen existing divides.

Signals

Accessibility standards: Adopted and enforced standards ensure learning environments accommodate learners with disabilities, socioeconomic barriers and varying connectivity levels, including low-bandwidth and offline options.

Assistive technology and design: Assistive technologies such as text-to-speech and adaptive interfaces are regulated and integrated across learning platforms, with mandatory age-appropriate design requirements.

Localized relevance: Access to multilingual and contextually appropriate materials, preventing cultural and socio-emotional disconnect of generic or misaligned digital content.

Problem-solving and collaborative learning

Are learning experiences intentionally designed to enforce desirable difficulty, requiring learners to solve problems and collaborate with others?

Rationale

The knowledge-based economy depends on individuals who can create new ideas, solve unfamiliar problems and work effectively with others. While AI can make learning more efficient and reduce friction, that friction is often the mechanism through which durable learning is formed.

Struggle, error and cognitive effort are essential for building deep understanding, reasoning skills and metacognitive habits, just as muscles strengthen under sufficient load.[72] Without intentional challenge, learners risk developing superficial competence: the ability to produce outputs without genuine understanding.

Embedding problem-solving and collaborative learning creates the conditions for deeper learning. Working through complex problems, particularly with others, reinforces long-term memory, analytical thinking and social skills while also maintaining the human connection that supports motivation and socio-emotional development.

Education systems must deliberately embed problem-solving and collaboration as intentional learning experiences, ensuring that learners do not bypass the cognitive effort required for deep learning.

Signals

Problem and project-based learning: Integration of consistent exposure to structured cognitive challenge and problem-solving through project and team assignments.

Teacher training: Availability of training and guidance for teachers on designing, facilitating and assessing problem-based and collaborative learning experiences.

Partnerships: Active partnerships with industry, civil society and community organizations to co-design real-world challenges, olympiads, hackathons and simulations integrated in the curriculum.

Lifelong and student-driven learning

Are learners supported throughout their lifetime with systems that track long-term progress, enable credit mobility across institutions, and give students meaningful control through transparent governance, consent and clear opt-out mechanisms?

Rationale

While early education plays a critical role in shaping cognitive development, particularly up to the early 30s,[73] education systems should not be designed to treat graduation as an endpoint but rather as a foundation for continuous learning. Children are naturally curious, and systems that nurture this curiosity from an early age lay the groundwork for lifelong learning.[74]

Inquiry-based and open-ended teaching methods reinforce this by placing students in charge of finding solutions, iterating, and improving, cultivating a drive to learn for its own sake rather than to satisfy external expectations.[75] These habits of inquiry, reflection and evidence-based thinking also build a lasting defence against misinformation with benefits that extend well beyond formal schooling.

Furthermore, rapidly changing economies and technologies are increasing the demand for continuous upskilling and adaptability. This requires stronger integration between early education and learning throughout adulthood. Yet structures that would bridge them, such as portable credentials, credit recognition across institutions and learner-owned records, remain underdeveloped in many education systems.

As systems increasingly track learner progress over time, they must be carefully designed. Transparency, consent and robust opt-out mechanisms are essential safeguards against the risk of determinism, where early data shapes future opportunities in ways learners cannot challenge or escape.

Signals

Credits record and portability: Interoperable systems and common standards to enable learner credentials and progress records to be transferred across institutions and providers, with transparent feedback mechanisms supporting continuity of learning.

Recognition of prior learning: A framework that formally recognizes skills and knowledge acquired outside traditional education settings.

Tracking learning across careers: Monitoring engagement in continuous and further education, active alumni relationship mechanisms.

Opt-out mechanisms: Meaningful control of credits, transparent governance, consent mechanisms and robust opt-out options to safeguard against misuse or determinism.

Inquiry-based learning development: Increased integration of open-ended, inquiry-based learning models across education systems that provoke curiosity and encourage exploration

Personalized and self-paced learning

Are learning pathways adapted to individual pace, needs and objectives, embedding student agency while leveraging AI to deliver tailored content, feedback and progression?

Rationale

Personalized learning has consistently been associated with improved learner outcomes.[76] However, fully tailoring education to each individual learner has historically been constrained by limited resources and scalability. Advances in AI and digital technologies are changing this, making it increasingly feasible to provide adaptive content, continuous feedback and flexible progression aligned with each learner's strengths, pace and objectives.

Yet, personalization is only valuable when learners remain active participants in shaping their own learning journeys. Embedding learner agency is essential to avoid the passivity that AI-generated pathways can create. When learners set goals, make choices and reflect on their progress, personalization strengthens metacognition, motivation and ownership of learning.

Personalization fundamentally relies on the use of personal and behavioural data. This raises important considerations around privacy, consent and governance. Transparent data practices, meaningful consent mechanisms and clear opt-out options are critical to ensure that personalization does not become surveillance.

When implemented responsibly, personalized and self-paced learning transforms AI from a shortcut into a scaffold, enabling students to learn more deeply, confidently and independently.

Signals

Adaptive learning systems: Systems that dynamically adjust content, pace and difficulty in response to individual learning progress, with human oversight ensuring that automation supports rather than replaces pedagogical judgement.

Mastery-based curriculum: Ability to advance based on demonstrated understanding rather than age and time spent, with flexible pathways that accommodate diverse speeds, strengths, weaknesses and learning objectives.

Learner agency: Measurement of learners' self-regulation, goal-setting within learning environments, ensuring that personalization reinforces rather than diminishes active engagement.

Conclusion

AI holds significant potential to enhance learning environments when deployed with a clear educational purpose and adequate system support. It can empower teachers by reducing administrative burdens, enabling more responsive and personalized learning pathways, and providing new analytical tools for understanding student progress. Yet the risks outlined throughout this paper, from cognitive offloading and misinformation to challenges around academic integrity and trust in knowledge, demonstrate that technological availability alone does not translate into educational progress. The decisive factor will be how institutions design governance, pedagogical practices and incentives that align technological innovation with the human development goals.

Current evidence has important limitations. Many of the long-term implications of generative AI for learning remain uncertain, and responsible policy-making requires acknowledging what is not yet known. The first cohorts of students who entered higher education before the widespread adoption of AI tools in 2022 are only graduating now, meaning that robust empirical evidence on cognitive development, academic outcomes and labour-market readiness is still emerging. Future research should therefore prioritize longitudinal studies on AI-assisted learning, adoption of new assessment models, and the development of governance frameworks that account for educational innovation, as well as the quality and reliability of knowledge. This includes examining whether what students are learning is accurate, whether knowledge is properly verified, and whether learning reflects genuine understanding rather than merely generated answers.

Responding effectively requires deliberate collaboration across education systems, governments, technology developers and civil society, not as an aspiration but as a practical necessity. No single actor controls the conditions required for AI to benefit learners; responsibility is inherently distributed across actors.

The opportunities and risks discussed throughout this paper demonstrate that technology alone does not determine educational outcomes. When AI and other emerging technologies are adopted without clear direction, they risk weakening the very cognitive capacities that education exists to cultivate. The goal, therefore, is not technology adoption for its own sake, but the deliberate alignment of innovation with the development of human capability. Ultimately, the defining question for education now is not how powerful AI becomes, but how deliberately societies choose to shape its role in learning to ensure education unlocks value for learners in the new economy and society.

Education systems have historic cases of adapting to profound societal, economic and technological change. The age of AI presents another such moment, one filled with uncertainty, but also possibility. If approached thoughtfully, AI can help create learning environments that are more adaptive, inclusive and capable of addressing real educational challenges. The task ahead is not simply to find use cases for AI within existing systems, but to prepare for future disruptions and opportunities by reimagining education in ways that align technological progress with the development of human potential.

The costs of inaction are not abstract. Every year, AI adoption in education continues without coordinated governance, the risks documented in this paper – cognitive atrophy, epistemic erosion, inequality of access and capability, and declining trust in credentials – become harder to reverse. The students currently navigating AI without guidance are developing habits, expectations and dependencies that will shape their capacity to learn for decades to come.

Shaping learning for future generations is only possible through constructive collaboration and deliberate preparation. The question this paper poses to every stakeholder is direct: are the conditions in place for AI to strengthen rather than weaken human learning? Where they are not, this framework identifies what needs to change, and how we can achieve this together. The choices made in the coming years will determine whether education systems harness AI to amplify human capability or allow it to replace it.

Contributors

Ostap Lutsyshyn
Lead, Education, Skills and Learning

Tanya Milberg
Manager, Education 4.0 and Education Initiatives

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Members of the Education 4.0 Alliance: Amel Karboul, Education Outcomes Fund; Andreas Schleicher, OECD; Andria Zafirakou, Alperton Community School; Angela Duckworth, University of Pennsylvania; Anna Tumadóttir, Creative Commons; Asheesh Advani, JA Worldwide; Asif Saleh, BRAC; Brian Johnsrud, Adobe; Chibeza Agley, Obrizum Group; Chung Jae Young, Korean Education and Research Information Service; David Edwards, Education International; David Treat, Pearson; Diana Heldfond, Parallel Learning; Fiorella Haim, Ceibal; Hadi Partovi, Code.org; Heather Johnson, Ericsson; Iglá Generoso, DIO; Isabelle Hau, Stanford Accelerator for Learning; Ivo Visak, AI Leap; Jean Daniel LaRock, Network for Teaching Entrepreneurship; Jeroo Billimoria, One Family Foundation; Jingbo Huang, UNU; Jirayut Srupsrisopa, Bitkub Capital; Jonghwan Patrick Park, Elite Education Group; Kevin Frey, Generation Unlimited; Lasse Leponiemi, HundrED; Laura Frigenti, Global Partnership for Education; Lydia Logan, IBM; Mariéme Jamme, iamtheCODE; Neha Shah, GEP; Njideka U. Harry, Youth for Technology Foundation; Pia Britto, UNICEF; Precious Moloi-Motsepe, Motsepe Foundation; Rebecca Winthrop, Brookings; Robert Palmer, Queen Rania Foundation for Education and Development; Sam Chaudhary, ClassDojo; Sherrie Westin, Sesame Workshop; Valerie Singer, Amazon Web Services; Wendy Kopp, Teach for All.

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World Economic Forum
91–93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744
contact@weforum.org
www.weforum.org