



## AI education policy: Building an intelligent education ecosystem

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### Abstract

With the rapid advancement of artificial intelligence technology, the education sector is confronting unprecedented opportunities for transformative change. AI technologies not only provide innovative solutions for personalized learning, enhanced teaching efficiency, and educational equity, but also pose significant challenges to traditional educational systems and policy frameworks. This study aims to investigate the formulation of effective AI education policies to establish a sustainable and innovative intelligent education ecosystem. Through comprehensive analysis of critical components constituting smart education ecosystems - including technological infrastructure, data resources, educators, learners, and digital platforms - the paper examines current global developments and emerging trends in intelligent education systems. Focusing on China's current AI education policy landscape, the research proposes targeted improvement strategies emphasizing strengthened policy support, enhanced AI literacy among educators, and robust data security measures to foster healthy development of intelligent education ecosystems. The findings demonstrate that constructing a comprehensive and efficient smart education ecosystem requires synergistic collaboration among government entities, educational institutions, and technology enterprises, coupled with flexible and forward-looking policy formulation. This multidimensional approach ensures the establishment of an adaptive framework that balances technological innovation with ethical considerations while maintaining educational quality and accessibility.

**Keywords:** Artificial intelligence, intelligent education ecosystem, education policy, personalized learning, educational equity

### Introduction

In recent years, the rapid advancement of artificial intelligence (AI) technology has profoundly transformed multiple industries, with particularly significant impacts on the education sector. Current applications of AI in education manifest primarily in personalized learning, adaptive learning systems, intelligent assessment and evaluation, virtual teaching assistants, and AI-powered tutoring. According to global educational technology market research, the AI education market is projected to experience substantial growth in the coming years, particularly in automated instruction delivery, customized learning pathways, and data-driven educational decision support systems<sup>[1]</sup>.

Modern AI systems leverage learning analytics to collect comprehensive student data, enabling the creation of tailored learning plans based on individual progress, interests, and needs<sup>[2]</sup>. These technologies further provide real-time feedback and intelligent tutoring support, granting students access to personalized educational assistance across temporal and spatial boundaries. As technological capabilities evolve, AI applications in education have expanded from initial teaching assistance to comprehensive support in educational policymaking, performance evaluation, and curriculum design<sup>[3]</sup>.

While AI demonstrates transformative potential in education, its integration poses substantial challenges to traditional pedagogical frameworks. Conventional education systems emphasizing teacher-centered instruction and standardized curricula increasingly conflict with AI-driven educational paradigms prioritizing personalized learning, data-informed decision-making, and intelligent assessment. This necessitates fundamental systemic transformation<sup>[4]</sup>. First, traditional classroom models struggle to adapt to AI-

enabled personalization and automation trends, requiring educators to transition from knowledge transmitters to learning facilitators and technological collaborators.

Secondly, the effective implementation of AI educational systems depends on extensive data infrastructure, raising critical concerns regarding privacy protection and data security. Many national education systems lack comprehensive legal frameworks to regulate AI applications, exacerbating risks of personal information breaches<sup>[5]</sup>. Furthermore, the successful integration of AI technologies demands enhanced digital literacy among educators, yet current professional development programs often inadequately address AI competency training<sup>[6]</sup>.

To address these challenges and maximize AI's educational potential, the concept of Intelligent Education Ecosystems (IEE) has emerged. An IEE transcends mere technological integration, encompassing dynamic interactions among policy frameworks, educators, learners, technology providers, and educational institutions. This ecosystem integrates AI capabilities, advanced analytics, and educational resources to achieve personalized, real-time, and universally accessible education<sup>[7]</sup>. By transcending traditional educational constraints, IEE enables customized content delivery aligned with individual learner profiles, significantly enhancing instructional effectiveness and student engagement. Through data-driven decision support systems, administrators can optimize resource allocation and accurately evaluate educational outcomes.

The IEE framework emphasizes multi-stakeholder collaboration involving governments, educational institutions, technology enterprises, and civil society. This necessitates well-designed AI education policies characterized by flexibility and foresight. Given the dynamic nature of educational development and continuous

AI innovation, policymaking must demonstrate adaptive responsiveness to emerging trends while proactively addressing future challenges<sup>[8]</sup>. Governments should establish supportive frameworks for technological innovation, implement comprehensive teacher training programs, develop robust data privacy mechanisms, and ensure equitable access to prevent technological disparities in education<sup>[9]</sup>. Thus, constructing an efficient and inclusive IEE represents both an inevitable technological progression and an essential pathway toward educational modernization. This study proposes actionable recommendations for policymakers and educational institutions through analysis of critical AI education policy elements. At the strategic level, policymakers should establish long-term objectives encompassing educational quality enhancement, equity promotion, and innovation cultivation. Concurrently, effective monitoring and evaluation mechanisms must ensure policy implementation fidelity and impact assessment.

Educational institutions must prioritize educator capacity building when deploying AI technologies. Successful AI integration requires not only technical infrastructure but also deep pedagogical engagement. Given the critical importance of teacher AI literacy, policies should mandate continuous professional development programs to enhance educators' technical proficiency and AI-adaptive teaching competencies<sup>[10]</sup>.

Finally, policy formulation should strengthen cross-sector collaboration, particularly between educational authorities and technology enterprises. Governments should facilitate innovation ecosystems that align technological development with pedagogical needs through coordinated platforms. This collaborative approach ensures the sustainable advancement of AI educational technologies while maintaining ethical standards and educational integrity.

### Development Status of Intelligent Education Ecosystems and AI Education Policies

The Intelligent Education Ecosystem (IEE) constitutes a multi-tiered, cross-domain composite system encompassing technological infrastructure, digital platforms, data resources, educators, learners, and policy frameworks. Through interdependent synergies among these components, the system evolves dynamically to accommodate technological advancements, societal demands, and shifts in educational paradigms, collectively driving pedagogical innovation and progress. The integration of AI technologies has transformed education from a unidirectional knowledge-transfer model to a data-driven ecosystem capable of delivering intelligent feedback and personalized learning pathways, thereby fostering more efficient, equitable, and flexible educational environments<sup>[11]</sup>. AI technologies provide intelligent support for educational platforms, while platforms serve as operational interfaces enabling user interactions. This symbiotic relationship underpins functionalities such as adaptive learning and automated assessment.

Data acts as the core driver of intelligent education, with AI leveraging real-time learning analytics to generate personalized insights. Efficient data collection and processing not only inform AI applications but also underpin data-driven educational decision-making. Educators utilize platform-generated learner data to refine instructional strategies, transitioning from traditional

knowledge transmitters to facilitators of learning processes and motivators of student engagement. Learners, positioned at the center of educational activities, increasingly rely on technological tools for self-directed learning. Policy frameworks play a critical role in sustaining IEE development by regulating educational technology adoption, ensuring ethical data practices, and promoting equitable resource distribution.

Globally, the convergence of 5G communication technology<sup>[12]</sup>, artificial intelligence (AI), the Internet of Things (IoT)<sup>[13]</sup>, big data, blockchain, and metaverse technologies<sup>[14]</sup> has catalyzed transformative educational explorations. Nations and regions are increasingly formulating AI education policies to govern and steer the application of intelligent technologies in education. These policies—encompassing laws, regulations, strategic plans, and action agendas—address AI deployment in education while systematically optimizing pedagogical practices, equity initiatives, and educator development. Their primary objectives include enhancing educational quality and efficiency, advancing equitable access, enabling personalized learning, and equipping stakeholders with modern technological competencies<sup>[15]</sup>.

### 1. Global Policy Developments

**United States:** A global leader in intelligent education, the U.S. has actively integrated AI and big data into personalized learning and resource optimization. Institutions like Coursera, Edmodo, and Knewton pioneered AI-driven adaptive learning platforms. U.S. policies prioritize equity and innovation, exemplified by Every Student Succeeds Act (ESSA), which bridges resource gaps for underserved communities<sup>[16]</sup>, and the National Education Technology Plan (NETP), which promotes nationwide digital transformation in education<sup>[17]</sup>.

**European Union:** The EU's Digital Education Action Plan (DEAP)<sup>[18]</sup> emphasizes digital upskilling and AI adoption in primary and secondary education. Finland exemplifies this trend, embedding personalized learning through digital tools and real-time feedback mechanisms<sup>[19]</sup>.

**China:** Rapid advancements in AI-education integration position China at the forefront of global innovation. The Education Informatization 2.0 Action Plan<sup>[21]</sup> accelerates AI, big data, and cloud computing applications in education, fostering platforms like VIPKID, Yuanfudao, and Zuoyebang. Emerging trends include AI-powered virtual instructors and nationwide "Internet + Education" initiatives.

**Asia-Pacific Leaders:** Japan, Singapore, and South Korea demonstrate significant progress. Singapore prioritizes "21st-century skills" through tech-enabled personalized learning, while South Korea's "Big Data-Driven Education Policy"<sup>[22]</sup> harnesses analytics for intelligent educational services.

### 2. Global Trends and Implications

The global proliferation of AI education policies underscores a shared commitment to systemic educational innovation. The fusion of AI and education not only redefines pedagogical models but also strengthens equity, quality, and efficiency through robust technological

frameworks. By establishing legal and ethical guidelines, these policies ensure that AI development aligns with educational objectives, mitigating risks of overreliance or misuse. Strategic policymaking enables nations to balance technological adoption with equitable resource distribution, addressing disparities while enhancing learning experiences and instructional outcomes.

As technological advancements and policy refinements continue, AI's role in education will become increasingly pivotal, driving the evolution of global educational ecosystems toward greater inclusivity, adaptability, and innovation.

## **Policy Framework for Constructing Intelligent Education Ecosystems**

### **1. Guiding Principles for AI Education Policy Design**

The formulation of an AI education policy framework is pivotal to advancing technological progress while ensuring sustainable and equitable educational development. To achieve these objectives, AI education policies should

**adhere to four core principles:** sustainability, inclusivity and equity, security and privacy protection, and alignment between technological innovation and educational needs.

#### **▪ Principle of Sustainability**

Sustainability serves as the cornerstone of AI education policies. Policymaking must address current technological requirements while establishing a foundational basis for the future evolution of education systems. This entails prioritizing the long-term impact of educational innovations to ensure enduring technological, social, and economic viability. First, policies must maintain flexibility to accommodate rapid AI advancements, incorporating dynamic adjustment mechanisms for ongoing technological evolution. Second, policies should foster a culture of innovation by encouraging educational institutions, educators, and learners to explore emerging AI applications, ensuring systemic adaptability. Finally, equitable resource allocation mechanisms must be institutionalized across regions and educational tiers to optimize resource utilization and prevent disparities.

#### **▪ Principle of Inclusivity and Equity**

This principle aims to eliminate educational inequalities by guaranteeing universal access to AI-enabled resources. Policymakers must address disparities stemming from urban-rural divides, socioeconomic gaps, and special educational needs. Strategies include expanding internet infrastructure, developing inclusive AI platforms, and ensuring equitable access to high-quality content. For learners with disabilities or unique requirements, policies should mandate AI-driven accommodations such as speech recognition, automated captioning, and adaptive tutoring systems. Furthermore, policies must promote diversified educational pathways enabled by AI, catering to varied learning styles and interests to enhance educational equity and accessibility.

#### **▪ Principle of Security and Privacy Protection**

The widespread adoption of AI in education necessitates stringent safeguards for data security and privacy. Policies must enforce compliance with data protection regulations (e.g., GDPR) and mandate encryption protocols for sensitive

student information. Transparent data governance frameworks should clarify collection methods, usage purposes, and processing procedures to build stakeholder trust. Additionally, policies must mitigate risks of data misuse and algorithmic bias by ensuring fairness in AI system design and operation. Strengthened cybersecurity measures, including protection against breaches and cyberattacks, should be institutionalized across educational organizations.

#### **▪ Principle of Aligning Innovation with Educational Needs**

Policies must ensure AI innovations directly address pedagogical objectives rather than pursuing technology for its own sake. AI tools should align with core educational goals—enhancing teaching quality, supporting learner personalization, and empowering educators. Crucially, AI should augment rather than replace teachers, with policies prioritizing professional development programs to enhance educators' technical proficiency. Concurrently, robust evaluation mechanisms must assess AI tools' impact on learning outcomes, enabling iterative improvements based on empirical evidence. Cross-disciplinary AI applications should be incentivized to foster holistic learning experiences through integrated knowledge systems.

These principles collectively form the foundation of AI education policy frameworks, ensuring technological advancements enhance educational quality, promote equity, safeguard privacy, and drive innovation. Within this framework, AI transcends its role as a mere technological tool, emerging as a vital enabler of equitable access and excellence in education. By harmonizing these principles, policymakers can establish resilient, future-ready educational ecosystems capable of addressing evolving societal and technological challenges.

## **Components of AI Education Policy Framework**

The AI education policy framework aims to promote effective application of AI technologies in education while ensuring educational equity, enhancing teaching quality, and fostering students' holistic development. To achieve these objectives, the framework should encompass four key components: technological infrastructure development, educational content and curriculum systems, teacher training and support, and data governance with privacy protection.

#### **▪ Technological Infrastructure Development: AI Technology R&D and Educational Platform Construction**

Technological infrastructure serves as the cornerstone for successful implementation of AI education policies. Strategic initiatives should promote AI technology innovation in education while optimizing educational platforms to better support teaching and administration.

First, policy support should prioritize AI technology R&D through establishing dedicated funds and innovation centers for educational AI development. This includes encouraging localized R&D to address specific educational needs and continuously upgrading educational algorithms, tools, and applications. Second, integrated AI education platform development requires policy guidance to create comprehensive systems incorporating instructional content, interactive tools, and assessment mechanisms. These platforms should enable teacher-student-parent connectivity

while supporting personalized learning and intelligent recommendation functions. Additionally, policies must address technological disparities by enhancing internet infrastructure in remote areas to ensure equitable access to AI-powered educational resources.

▪ **Educational Content and Curriculum Systems: AI-Driven Curriculum Design and Innovation**

AI technologies not only serve as teaching tools but also profoundly influence curriculum content and pedagogical design. Policy frameworks should drive educational content innovation to meet evolving societal and technological demands.

First, AI-driven curriculum design enables dynamic optimization through data analysis and intelligent recommendations. This allows educators to adjust content and create personalized learning plans tailored to individual student needs. Policy support should facilitate interdisciplinary AI curriculum development that integrates mathematics, science, humanities, and arts to cultivate comprehensive competencies. Second, personalized learning should become a core curriculum design principle. AI systems can customize learning pathways based on students' interests, progress, and capabilities, moving beyond standardized teaching models. Furthermore, real-time data feedback mechanisms empower educators to promptly identify learning difficulties and adapt instructional strategies through AI-powered analytics.

▪ **Teacher Training and Support: Enhancing AI Literacy and Pedagogical Capacity**

Teachers constitute the crucial element in successful AI education implementation, necessitating policy investments in AI literacy enhancement and teaching capacity building.

First, systematic AI literacy programs should be institutionalized, covering fundamental AI knowledge, practical applications in education, and AI-enhanced classroom management techniques. Continuous professional development through regular training and workshops will help teachers keep pace with technological advancements. Second, policies should encourage innovative teacher-AI collaboration models that effectively integrate AI into instructional design, learning analytics, and personalized mentoring. AI should evolve from auxiliary tools to integral components of educational interactions. Finally, comprehensive support systems must provide technical resources and troubleshooting assistance to help teachers overcome implementation challenges and maximize educational outcomes.

▪ **Data Governance and Privacy Protection: Regulatory Framework and Ethical Standards**

As AI becomes prevalent in education, data governance and privacy protection emerge as critical policy priorities. Stringent measures must safeguard sensitive information including personal data of students and teachers.

Policies should establish robust data security regulations ensuring compliance with domestic and international legal requirements such as China's Personal Information Protection Law (PIPL) and the EU's General Data Protection Regulation (GDPR). Transparent privacy protection standards must clarify data usage permissions while ensuring transparency and fairness in data practices. Ethical governance of AI systems requires particular

attention, mandating fairness audits to eliminate algorithmic biases and discrimination. Furthermore, data collection must adhere to informed consent principles, empowering students, parents, and teachers to maintain control over personal information, thereby building trust in AI educational systems.

These interconnected components form a comprehensive, adaptable, and sustainable AI education ecosystem. Through multidimensional policy guidance, education systems can maximize AI's potential while ensuring privacy and security, ultimately enhancing educational quality, promoting equity, and delivering personalized, innovative learning experiences. Such policies not only cultivate future-ready talents but also contribute valuable insights to global educational reform initiatives.

**Current Status and Development Recommendations for China's AI Education Policies**

**1. Current Status of China's AI Education Policies**

In recent years, China has actively promoted innovation and development in AI-enabled education, with the government introducing a series of policies to advance AI applications in education while addressing challenges such as educational resource inequality and quality improvement [23]. As AI technology rapidly evolves, its integration into educational processes—from administrative management to classroom instruction and personalized learning—has brought transformative changes to China's education system.

The Chinese government has prioritized AI applications in education, issuing multiple policy directives to guide and support this transformation. The Education Informatization 2.0 Action Plan (2018) emphasizes the deep integration of next-generation technologies such as big data, cloud computing, and AI with teaching practices, aiming to build a smart education ecosystem. This policy explicitly mandates the accelerated development of educational informatization, enhanced digital resource construction, and the improvement of intelligent education services.

Furthermore, the New Generation Artificial Intelligence Development Plan (2021) identifies AI education as a key focus area, calling for the rapid deployment of AI applications in education, talent cultivation, and the establishment of exemplary smart education pilot zones. These national-level policies provide robust institutional support for the widespread adoption and implementation of AI technologies in education. In practice, AI technologies are already being applied across multiple domains, including educational administration, teaching assistance, and personalized learning. From AI-powered homework grading and adaptive learning recommendation systems to virtual instructors and smart classroom solutions, AI is reshaping traditional educational paradigms.

In advancing AI-enabled education, China has adopted a dual strategy of leveraging existing technological applications while significantly increasing investments in AI education R&D. Domestic enterprises and research institutions are spearheading innovations in critical fields such as speech recognition, natural language processing (NLP), and intelligent recommendation systems, driving transformative upgrades in educational technologies. Speech recognition technology enables precise interpretation of student voice inputs and generates real-time feedback, enhancing interactive learning experiences. NLP-powered systems demonstrate advanced capabilities in

comprehending student inquiries and delivering contextualized responses, providing robust technical support for remote and online education platforms. Big data integration empowers education administrators to conduct macro-level analyses of institutional and societal educational data, enabling evidence-based policymaking and strategic planning. Through granular analysis of student behavioral data, educators can identify individual learning patterns, cognitive preferences, and competency gaps, thereby facilitating hyper-personalized educational interventions.

This multidimensional approach not only optimizes teaching efficacy but also establishes a data-driven

## 2. Challenges and Improvement Recommendations for China's AI Education Policies

Despite notable progress in advancing AI-enabled education, China faces multifaceted challenges in practical implementation.

### 1. Policy-Tech Misalignment

Existing policy frameworks often lag behind the rapid evolution of AI technologies, particularly in regulating technical specifications, data usage for teachers and students, and operational standards for AI education platforms. The absence of unified legal guidelines increases risks such as technology misuse and data breaches. Ethical dilemmas—including fairness in AI-driven grading and algorithmic biases in personalized learning—remain inadequately addressed under current laws.

#### Recommendations

**Strengthen Legal Frameworks:** Develop specialized AI education legislation to clarify norms for technology development, data governance, and privacy protection. Adopt international best practices to establish ethical AI standards, ensuring alignment with educational values and equity.

**Enhance Policy Agility:** Implement dynamic policy updates through regular impact assessments of AI technologies. Establish advisory committees to monitor emerging issues and propose timely regulatory adjustments.

### 2. Regional Disparities in Technology Access

Significant gaps persist between urban and rural areas, as well as across eastern, central, and western regions, in terms of infrastructure, resources, and teacher capacity. Many remote schools lack basic equipment and stable internet connectivity, hindering AI adoption.

#### Recommendations

**Accelerate Smart Infrastructure Development:** Prioritize investments in underdeveloped regions through government subsidies and public-private partnerships to upgrade hardware, networks, and cloud-based platforms.

**Foster Resource Sharing:** Leverage AI-powered online platforms and virtual classrooms to distribute high-quality educational content nationwide. Develop cross-regional collaboration programs to bridge urban-rural divides.

**Tailored Regional Policies:** Design differentiated strategies—promoting advanced AI integration in developed

areas while focusing on foundational infrastructure and teacher training in underserved regions.

### 3. Insufficient Teacher AI Literacy

Many educators, particularly in K-12 schools, lack the technical proficiency to effectively utilize AI tools, limiting the technology's transformative potential.

#### Recommendations:

**Comprehensive Training Programs:** Launch nationwide AI literacy initiatives, including mandatory workshops, online certification courses, and peer-learning networks. Integrate AI pedagogy into teacher education curricula.

**Teacher-Tech Collaboration:** Encourage partnerships between educators and AI developers to co-design classroom-ready tools. Establish innovation hubs for piloting AI-enhanced teaching methodologies.

**Sustainable Support Systems:** Provide continuous technical assistance and performance-based incentives to motivate teachers in adopting AI solutions.

### 4. Data Security and Privacy Risks

The extensive collection and analysis of student data (e.g., learning behaviors, academic performance) for AI-driven personalization raise critical concerns about data misuse and insufficient transparency.

#### Recommendations

**Legislative Safeguards:** Enact dedicated AI education data protection laws aligned with global standards like PIPL and GDPR, specifying data scope, consent mechanisms, and retention periods.

**Advanced Technical Protections:** Mandate end-to-end encryption, anonymization techniques, and regular third-party security audits for all educational AI systems.

**Transparency Protocols:** Require platforms to disclose data practices in plain language, obtain explicit user consent, and establish accessible grievance redress mechanisms.

China's AI education journey confronts interconnected challenges spanning policy gaps, regional inequities, teacher readiness, and data governance. Addressing these requires coordinated efforts among policymakers, educators, and tech stakeholders to:

Modernize legal frameworks to keep pace with innovation; Bridge infrastructure and resource divides through targeted investments; Upskill educators as AI-enabled pedagogical leaders; Embed ethical data practices into technological design.

By implementing these reforms, China can cultivate a secure, equitable, and future-ready AI education ecosystem that maximizes technology's benefits while safeguarding fundamental educational values. Such systemic advancements will not only enhance domestic education quality but also position China as a global benchmark in AI-driven educational transformation.

#### Conclusion

The rapid advancement of artificial intelligence is ushering in an unprecedented transformation in education. AI technologies hold immense potential to enhance

pedagogical efficacy, optimize resource allocation, and trigger paradigm shifts in educational models. Realizing this vision demands robust AI education policies and the systematic construction of intelligent education ecosystems. Globally, nations exhibit distinct trajectories in AI-enabled education. Developed countries have deeply integrated AI to drive systemic educational reforms, while developing economies like China confront multifaceted challenges, including uneven technological distribution, insufficient teacher AI literacy, and persistent data security risks. Addressing these issues necessitates collaborative efforts among governments, educational institutions, and technology enterprises. Based on China's current landscape, this study proposes three strategic recommendations:

**Long-term Policy Integration:** Align technological innovation with educational reform through forward-looking policies that incentivize R&D while safeguarding ethical standards.

**Teacher Empowerment:** Implement nationwide AI competency programs to equip educators with skills for effectively harnessing AI tools in curriculum design and personalized instruction.

**Data Governance Reinforcement:** Establish stringent data protection frameworks compliant with international benchmarks (e.g., GDPR, PIPL) to balance AI-driven personalization with privacy preservation.

Looking ahead, building a resilient smart education ecosystem requires tripartite synergy:

Governments must adopt agile regulatory frameworks to address emerging technological and ethical challenges. Educational institutions should enhance digital governance capabilities and foster AI-augmented pedagogical practices. Technology providers need to prioritize education-centric innovations, delivering scalable, secure, and equitable solutions.

In essence, crafting AI education policies transcends technological adoption—it represents a multidimensional endeavor harmonizing pedagogical philosophies, teaching methodologies, educator competencies, and technical infrastructure. Only through collective societal commitment can we achieve a transformative, intelligent education system characterized by personalization, inclusivity, and equity. This evolution will not only redefine educational paradigms but also lay a robust foundation for future-ready learning ecosystems worldwide, ultimately charting new pathways for global educational advancement.

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