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State-Engineered Pedagogy: Deconstructing China's "AI+" Action in a New Era of Geopolitical Competition

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Abstract

This paper provides a systematic deconstruction of the education-focused provisions within China's 2025 State Council directive, the "AI+" Action (Guo Fa No. 11). It introduces and develops the theoretical framework of "state-engineered pedagogy"—the deliberate, top-down use of technology by a state to systematically reshape teaching and learning processes to align with national economic and strategic objectives. Utilizing a methodology of policy text analysis, comparative policy mapping, and illustrative case studies substantiated with independent evidence, this paper argues that China's strategy aims to construct a new human-machine collaborative learning paradigm with a dual purpose: to drive domestic educational reform and to cultivate a future workforce capable of securing long-term technological self-reliance and shaping global standards. Through a multi-layered analysis of the policy's architecture, historical evolution, international context, and ethical risks, this paper contends that while the "AI+" mandate promises unprecedented personalization, it also introduces profound risks related to data privacy, algorithmic governance, and the creation of an "algorithmic panopticon." The execution of this policy thus serves as a critical case study in 21st-century statecraft and the global contest over the future of technology and society.

Keywords State-Engineered Pedagogy; "AI+" Action (Guo Fa No. 11, 2025); Human Machine Collaboration & Large-Scale Personalization; Data Privacy & Algorithmic Governance; Geopolitical Competition & Technical Standard-Setting.

1 Introduction: A New Paradigm of State-Engineered Pedagogy

The issuance of the State Council's directive, Guo Fa No. 11, titled "Opinions on Deeply Implementing the 'AI+' Action," marks a national inflection point in China's development trajectory.[1] Far from being a narrow sectoral reform, the directive articulates a grand strategy for societal transformation, explicitly leveraging Artificial Intelligence (AI) to "remodel human production and life paradigms" and achieve a "revolutionary leap in productivity".[1] This document frames AI not merely as an enabling technology but as the core engine for constructing a new national architecture—an "intelligent economy and intelligent society" designed to propel China's modernization.[1] Within this sweeping blueprint, the provisions dedicated to education emerge as a foundational pillar, the cornerstone upon which the larger ambitions of the "AI+" action rest.

This paper advances the thesis that China's "AI+" education strategy represents a new paradigm of state-engineered pedagogy: the deliberate, top-down use of technology by a state to systematically reshape teaching and learning processes to align with national economic, political, and strategic objectives.[1] This concept moves beyond simple "EdTech adoption" to a model of centrally planned pedagogical transformation, where the state acts as the primary architect, funder, and enforcer of a new educational reality.[1] This framework draws upon a rich history of scholarship examining how educational forms are shaped by broader societal and professional imperatives, such as the development of "signature pedagogies" in engineering and other fields, which are designed to inculcate specific

ways of thinking and acting that serve a particular professional or national purpose.[3] In this case, the pedagogy is being engineered not just for a profession, but for the nation itself.

The political-economic imperative underpinning this educational transformation is the state's urgent need to cultivate "new quality productive forces", or xīnzhì shēngchǎnlì.[1] This crucial concept, central to recent high-level policy discourse, serves as the theoretical justification for the "AI+" Action.[5] In the face of significant demographic headwinds—namely a shrinking workforce and an aging population—the state can no longer rely on labor quantity to drive economic growth and maintain social stability.[1] The "AI+" Action is therefore a direct economic intervention designed to resolve this fundamental contradiction. It represents a strategic pivot where the state is betting that AI-augmented human capital can generate a sufficient productivity multiplier to offset demographic decline.[1] In this context, education is instrumentalized as the primary lever for reconfiguring the nation's core comparative advantage, shifting from an economic model reliant on the quantity of its labor to a new model predicated on the quality of its talent and its mastery of technology.[1]

This reframing of education as a tool of macroeconomic policy and national security is evident throughout the policy's design. The consistent emphasis on achieving a "revolutionary leap in productivity" and serving the overarching project of "Chinese-style modernization" situates the educational reforms firmly within a national economic strategy.[1] Furthermore, the explicit inclusion of concepts like "AI technology sovereignty" and the need for students to examine AI from a "national scientific and technological strategic perspective" within the senior high school curriculum reveals a direct fusion of national security objectives with pedagogical content.[1] This approach is not primarily concerned with fostering well-rounded citizens in a liberal-humanistic tradition; rather, its goal is to cultivate a generation of citizens who are technically proficient and instinctively aligned with the state's strategic imperatives. This stands in stark contrast to the policy language prevalent in the United States and the European Union, which, while acknowledging the importance of economic competitiveness, is predominantly framed in terms of student literacy, teacher empowerment, data privacy, and ethical safeguards.[6]

This paper, therefore, argues that China's "AI+" education strategy is a sophisticated instrument of statecraft, designed to resolve internal social and economic pressures while simultaneously constructing the human capital foundation required to project power and influence externally in an intensifying global technological race. The analysis will proceed by deconstructing the policy's architecture, tracing its methodical evolution, comparing it to global models, examining its implementation through the EdTech ecosystem, critiquing its profound ethical implications, and finally, assessing its long-term geopolitical consequences.

2 The Architectural Blueprint: Policy, Pedagogy, and Personalized Learning at Scale

The strategic vision of the "AI+" directive is translated into an actionable plan through a meticulously crafted architectural blueprint for educational reform. This section provides a systematic deconstruction of the policy's text to reveal its internal logic and operational design, demonstrating how abstract state ambitions are translated into a concrete, actionable, and technologically mediated pedagogical framework.

2.1 Mandate for Total Integration

A close textual analysis of the directive's core education clause reveals a mandate for profound and systemic change. The call to "integrate artificial intelligence into all elements and processes of education and teaching" (bǎ réngōngzhìnéng róngrù jiàoyù jiàoxué quán yàosù, quán guòchéng) is a declaration of intent for total integration.[1] This language signifies a deliberate departure from previous models of technology adoption, which were often piecemeal, optional, or limited to specific subjects or pilot schools. The "AI+" vision is one where AI is not an add-on but a foundational layer of the entire educational ecosystem, permeating every aspect of teaching, learning, management, and assessment.[1]

2.2 Human-Machine Collaborative Learning

Central to this vision is the innovation of "new human-machine collaborative education and teaching models".[1] This phrase delineates the envisioned relationship between AI and human actors, introducing two key concepts into the official lexicon. The first are "Intelligent Tutors" (zhìnéng xuébàn), conceived as personalized, student-facing AI companions designed to provide continuous, adaptive guidance, feedback, and support.[1] The second are "Intelligent Teachers" (zhìnéng jiàoshī), which are AI systems intended to augment and collaborate with human

educators, handling tasks from assessment and content delivery to data analysis.[1] This model of augmentation, rather than outright replacement, aligns with expert analyses suggesting that the complex, social, and creative aspects of the teaching profession are not easily automated.[1] The policy thus envisions a future where human teachers are liberated from routine work to focus on higher-value tasks like mentorship, fostering creativity, and providing socio-emotional support.

2.3 From Knowledge Transmission to Capability Enhancement

The ultimate operational goal of this human-machine collaborative model is to "accelerate the realization of large-scale personalized education" (guīmóhuà yīncáishījiào).[1] This objective powerfully connects a deeply rooted pedagogical ideal in Chinese culture—yīncáishījiào, or "teaching according to aptitude," a concept dating back to Confucius—with the power of modern technology.[1] For centuries, true personalization has been an elusive goal, achievable only in small-scale, resource-intensive settings. The state now views AI as the first technological tool capable of breaking this constraint, of solving what the technology sector has termed the "impossible triangle" of delivering education that is simultaneously personalized, high-quality, and scalable to a national level.[1] This objective is underpinned by a fundamental pedagogical paradigm shift: the explicit goal to move the focus of education from "knowledge transmission" (zhīshì chuánshòu) to "capability enhancement" (nénglì tíshēng).[1] This signals a move away from rote memorization and toward the cultivation of higher-order skills such as critical thinking, creativity, and problem-solving—competencies deemed essential for thriving in a complex, AI-driven world.

2.4 The Official Competency Framework

This high-level policy mandate is given granular detail through official interpretations and guidelines, most notably the Guidelines for Primary and Secondary School Artificial Intelligence General Education (2025 Edition) released by the Ministry of Education.[1] This framework translates the "AI+" vision into a concrete curriculum, defining AI literacy not just as technical skill but as a holistic, "four-in-one" integration of knowledge, skills, thinking, and values.[1] The curriculum is designed as a "tiered, progressive, and spiraling" system, with specific, age-differentiated learning objectives for each educational stage.[1] While the primary and junior high school stages focus on fostering interest and understanding basic principles, the objectives for the senior high school stage become significantly more sophisticated, directly linking AI education to national strategic priorities.[1] Students are expected to understand the role of AI in national strategies like smart cities and defense. The focus shifts to innovative application, including building and optimizing simple AI models and developing interdisciplinary solutions. Critically, the curriculum aims to foster systemic thinking, encouraging students to analyze AI through a three-dimensional lens of "technical principles—system architecture—social impact".[1] The "values" component is also elevated, tasking students with examining "AI technology sovereignty from a national scientific and technological strategic perspective" and balancing innovation with social risk in complex ethical scenarios.[1] This demonstrates a curriculum designed not merely to create skilled technicians but to cultivate a generation of citizens who instinctively view AI development through the lens of national interest, security, and strategic imperatives.

To systematically connect the high-level policy language to concrete implementation, the following table provides a mapping framework. It makes the state's abstract vision tangible and analyzable, transforming the analysis from a purely textual interpretation into a quasi-empirical framework that demonstrates how state ideology is operationalized through bureaucratic and technological systems.

3 The Evolutionary Trajectory: A Decade of Methodical Statecraft

The 2025 "AI+" directive, while transformative in its scope and ambition, did not emerge from a vacuum. It represents the culmination of a long-term, iterative, and methodical process of state-led experimentation and scaling. This evolutionary trajectory demonstrates a key characteristic of Chinese governance that confers a significant strategic advantage: the capacity for patient, long-term policy implementation. This approach treats large-scale policy implementation not as a purely political process of negotiation and compromise, but as a systems engineering problem to be solved through a logical sequence of prototyping, testing, data collection, refinement, and mass production.

Table 1: Policy Mechanism Indicator Mapping for China's "AI+" Education Strategy

Policy Clause (from Guo Fa No. 11)	Analytical Concept	Implementation Mechanism	Observable Indicator
"Innovate new human-machine collaborative teaching models such as 'Intelligent Tutors' and 'Intelligent Teachers'"[1]	Intelligent Tutors/Teachers	National Smart Education Platform; tech partnerships with firms like iFlytek; teacher training pilot programs in regions like Ningxia.[1]	Platform user adoption rates; number of schools with deployed "Smart Classrooms"; teacher training coverage (%).
"Shift the focus of education from knowledge transmission to capability enhancement"[1]	Capability-Oriented Pedagogy	Ministry of Education's K-12 AI Literacy Guidelines; introduction of project-based learning modules; development of new assessment frameworks.[1]	Share of curriculum dedicated to AI literacy (%); student performance on problem-solving and creative tasks versus rote memorization tasks.
"Accelerate the realization of large-scale personalized education (yīncáishījiào)"[1]	Personalization at Scale	Deployment of adaptive learning systems in designated Smart Education Demonstration Zones; promotion of AI tools on national platforms.[1]	Student-to-teacher ratio in AI-supported learning environments; usage data of adaptive learning modules; number of personalized learning paths generated.

3.1 Tracing the Policy Lineage

The genesis of China's national AI education strategy can be traced back to the State Council's landmark 2017 New Generation AI Development Plan.[1] This foundational document was the first to articulate a national vision for AI supremacy and explicitly identified education as a critical domain. It mandated the promotion of "universal AI education" and called for the progressive introduction of AI-related courses into primary and secondary school curricula, setting the strategic direction for all subsequent actions.[1]

Following this high-level declaration, the Ministry of Education began the process of operationalization. The 2018 AI Action Plan and the concurrent Education Informatization 2.0 policy translated the 2017 vision into concrete administrative steps, kickstarting the practical work of developing and integrating AI and coding content into official curricula and establishing the first large-scale teacher training programs.[1] A particularly crucial step in this evolutionary path was the 2018 launch of the "AI to Assist in the Construction of the Teaching Force" pilot program, implemented in the Ningxia Hui Autonomous Region.[1] This program served as a vital testing ground for the core concepts that would later feature prominently in the 2025 "AI+" directive. The Ningxia pilot experimented with developing "teacher intelligent assistants," using AI for personalized professional development, and constructing a "teacher big data" platform to optimize management—all direct precursors to the more sophisticated "Intelligent Teacher" model envisioned in the 2025 plan.[1] This initiative provided invaluable practical experience, allowing policymakers to understand real-world challenges and opportunities before attempting a nationwide rollout.

3.2 The "Pilot-to-Scale" Governance Model

The progression from the 2017 plan to the 2025 directive exemplifies China's characteristic governance model: using designated pilot zones and experimental projects to test, refine, and validate policies before committing to large-scale national implementation.[1] In addition to the teacher-focused pilots, the state designated numerous "Smart Education Demonstration Zones" (zhìhuì jiàoyù shìfàn qū) in major urban centers such as Fuzhou, Guangzhou, Wuhan, and Shanghai's Minhang district.[1] These zones functioned as comprehensive laboratories for educational innovation. Local governments, in partnership with schools and technology companies, were encouraged to experiment with a wide range of applications, from building intelligent campus infrastructure and developing digital teaching resources to exploring new data-driven governance models.[1] These pilots generated a wealth of data and a portfolio of "exemplary cases" that informed national policymakers, highlighting best practices, identifying potential pitfalls, and building a repository of proven solutions that could be scaled up.[1] This approach allowed for a degree of localized adaptation and experimentation within a centrally directed framework, ensuring that the final national policy was grounded in practical experience rather than abstract theory. This "test, refine, scale" methodology minimizes

the risk of large-scale failure and ensures that by the time of the national rollout, the technological, bureaucratic, and political groundwork has already been laid. It contrasts sharply with the often more fragmented, politically contingent, and reactive policy cycles observed in many Western democracies, where sharp ideological shifts driven by elections can lead to reversed or abandoned initiatives.[1]

3.3 The 2025 Inflection Point

Viewed against this historical backdrop, the 2025 "AI+" directive marks a critical inflection point. It represents the decisive shift from a phase of introduction, experimentation, and piloting to one of mandatory, systemic, and nationwide integration.[1] The language of the policy reflects this transition. Whereas earlier documents "called for" or "encouraged" the introduction of AI courses, the 2025 directive mandates its infusion into the "whole process of education," signaling that the experimental phase is over.[1] The state, having validated its models and built sufficient capacity through years of preparatory work, is now moving to consolidate and universalize its vision across the entire country. The following timeline visually represents this methodical, phased progression.

Figure 1: China's AI Education Policy Evolution Timeline (2017-2025)

2017: The process began with the *New Generation AI Development Plan* from the State Council, establishing a top-level national strategic mandate. The technological apparatus was in a conceptual stage, with an emphasis on programming education.

2018: The Ministry of Education released the *AI Innovation Action Plan for Higher Education* and *Education Informatization 2.0*. Institutionally, this led to the "AI to Assist Teacher Workforce" pilot in Ningxia, which focused on prototyping "Teacher Intelligent Assistant" systems.

2019–2024: This period saw the continuous advancement of these initiatives. Institutionally, "Smart Education Demonstration Zones" were created in multiple cities. Technologically, this involved the deployment of city-level education data platforms and campus-level "Smart Classrooms."

2025: The State Council issued the *"AI+" Action (Guo Fa No. 11)*, which serves as a mandatory nationwide integration directive. The technological goal is the scaled deployment of "Intelligent Tutors/Teachers" via national platforms.

4 A Global Matrix of Governance: Comparative Approaches to AI in Education

The distinctiveness of China's state-engineered approach is thrown into sharp relief when placed in a comparative international context. The divergent strategies of the United States, the European Union, and Singapore are not merely different policy choices but reflect fundamentally different philosophies about the relationship between the state, the market, the individual, and technology.

4.1 Four Models of Governance

An analysis of global approaches reveals four distinct models of governance for AI in education:

1. China (State-Engineered): China's approach is unequivocally top-down, systematic, and mandatory. The "AI+" action is a central government directive that cascades down through the administrative hierarchy, aiming for rapid, uniform, and nationwide adoption. The strategy is deeply interwoven with national goals of technological self-reliance and global competitiveness, with the state acting as the primary architect, funder, and enforcer of the entire initiative.[1]

2. United States (Market-Collaborative): In contrast, the United States employs a model that is policy-driven but fundamentally collaborative and market-oriented. The 2025 Executive Order "Advancing Artificial Intelligence Education for American Youth" does not mandate a national curriculum but instead establishes a framework to encourage and facilitate AI education through public-private partnerships.[1] Government agencies like the National Science Foundation (NSF) provide grants and coordinate efforts, but the actual development of educational resources is largely left to industry, academia, and non-profit organizations.[1] This "empowerment" model is further constrained by a robust public debate and widespread skepticism regarding student data privacy and algorithmic fairness, creating a more cautious and contested environment for adoption.[1]

3. European Union (Ethics-Regulatory): The EU's approach is distinguished by its emphasis on norms, regulation, and ethics. The *Digital Education Action Plan (2021-2027)* and the landmark *AI Act* prioritize the creation

of a "high-performing digital education ecosystem" explicitly conditioned on upholding fundamental values.[1] The strategy is to lead globally through the establishment of a comprehensive regulatory environment that ensures AI is trustworthy, transparent, and human-centric.[1] The focus is less on the speed of deployment and more on ensuring that deployment is done correctly and ethically, with most educational AI applications classified as "high-risk" systems subject to strict obligations regarding transparency, data governance, and human oversight before they can enter the market.[1]

4. Singapore (Pragmatic-Centralized): Singapore presents a hybrid model that combines strong state direction with pragmatic, innovation-focused implementation. The *EdTech Masterplan 2030* reflects a clear, centrally planned vision.[1] However, its execution is highly targeted and efficiency-driven, channeled through a single national platform: the Singapore Student Learning Space (SLS).[1] Instead of a broad mandate, Singapore's Ministry of Education has focused on developing and integrating specific, well-defined AI tools, such as an Adaptive Learning System for mathematics and Learning Feedback Assistants for writing, prioritizing proven solutions that solve specific pedagogical problems within a controlled ecosystem.[1]

4.2 A Global Strategic Matrix

To systematically conceptualize these differences, the following four-quadrant matrix maps the four polities along two key axes: the governance model (from market-collaborative to state-engineered) and the primary strategic driver (from a focus on regulation and ethics first to a focus on rapid deployment and scale first). This novel visualization provides a powerful conceptual tool for understanding the fundamental philosophical divides in global AI governance, moving beyond a simple list of differences to a structured, analytical framework that reveals the underlying logic of each approach.

Figure 2: Four-Quadrant Governance Matrix of Global AI in Education Strategies

This matrix is organized along two axes: Governance Model (Market-Collaborative vs. State-Engineered) and Strategic Driver (Deployment & Scale First vs. Regulation & Ethics First).

Quadrant I (State-Engineered / Deployment & Scale First): China. Policy tools include mandatory national directives like Guo Fa No. 11, Smart Education Zones, and partnerships with state-aligned enterprises. The key characteristic is an emphasis on rapid, uniform, nationwide adoption to achieve strategic state goals.

Quadrant II (Market-Collaborative / Deployment & Scale First): United States. Policy tools include Executive Orders, public-private partnerships (PPPs), NSF grants, and Presidential AI Challenges. The approach is reliant on market innovation and local autonomy but is strongly constrained by public opinion on data privacy.

Quadrant III (State-Engineered / Regulation & Ethics First): Singapore. Policy tools include a central masterplan (EdTech Masterplan), a unified national platform (SLS), and targeted AI tool integration led by GovTech. The approach is pragmatic and efficient under central control, prioritizing solving specific pedagogical problems.

Quadrant IV (Market-Collaborative / Regulation & Ethics First): European Union. Policy tools include the AI Act (classifying education AI as "high-risk"), GDPR, and pan-EU funding. The approach emphasizes compliance, transparency, and human oversight, with the legal framework preceding large-scale deployment.

The granular data supporting this conceptual matrix is provided in the table below, which compares the four polities across specific, concrete features of their AI in education strategies. It provides the evidence-based data that supports the conceptual framework of the Four-Quadrant Matrix, allowing readers to see precisely how the different governance philosophies translate into tangible policy choices.

5 From Ambition to Application: China's EdTech Ecosystem as a State Instrument

The ambitious vision laid out in the "AI+" directive is not merely a theoretical construct; it is being actively translated into practice by a vibrant and sophisticated educational technology (EdTech) ecosystem. This section bridges the gap from high-level policy to on-the-ground implementation by examining illustrative case studies of leading Chinese EdTech companies. These firms are not only responding to the state's mandate but are also developing the core technologies that make the vision of large-scale, personalized, human-machine collaborative learning a tangible reality. The cases are presented as "illustrative" to show the mechanism of implementation, not to make definitive causal claims about efficacy without independent evidence.

Table 2: A Comparative Analysis of National AI in Education Strategies

Feature	China	United States	European Union	Singapore
Core Policy/Directive	"AI+" Action (Guo Fa No. 11)	Executive Order "Advancing AI Education for American Youth"	Digital Education Action Plan (2021-2027); AI Act	EdTech Masterplan 2030
Governance Model	Top-down, state-mandated, centrally planned.	Bottom-up, collaborative, public-private partnerships.	Regulatory, normative, supranational guidance for member states.	Centralized, state-led implementation via a national platform.
Key Priorities	Personalization at scale, capability enhancement, national competitiveness, educational equity.	K-12 AI literacy, workforce development, innovation, teacher training.	Ethics, data privacy, digital competence, inclusivity, teacher readiness.	Personalized learning, efficiency, teacher augmentation, specific tool deployment.
Implementation	Mandatory curriculum integration, pilot zones for scaling, national platforms (e.g., Smart Education).	Grant programs (NSF), Presidential Challenges, development of online resources by partners.	Ethical guidelines, funding (Erasmus+), Digital Education Hub, competence frameworks (DigCompEdu).	Integration into national Singapore Student Learning Space (SLS), targeted AI tool rollout.
Primary Challenge	Algorithmic control, data privacy, stifling creativity, rural-urban digital divide.	Public skepticism, data privacy concerns, equitable access, political fragmentation.	Bridging digital skills gaps, harmonizing policies across 27 member states, avoiding over-regulation.	Ensuring teacher readiness, data security, scaling beyond pilot programs.

5.1 Case Study 1: Squirrel AI and the Pursuit of Hyper-Personalization

Squirrel AI (松鼠 AI) stands as a prime exemplar of the private sector's role in realizing the state's goal of "large-scale personalized education".[1] The company has developed one of China's most advanced AI-powered adaptive learning systems, which directly addresses the directive's call for a shift towards individualized instruction. The core of Squirrel AI's technology lies in its granular approach to knowledge. The system deconstructs entire subjects, such as mathematics and physics, into thousands of "nano-scale" knowledge points, creating a highly detailed knowledge graph.[1] Through an initial diagnostic assessment, the AI engine can pinpoint a student's specific knowledge gaps with a precision that would be impossible for a human teacher to achieve in a traditional classroom setting, enabling a truly personalized learning path.[1] This approach embodies the principle of yīncáishījiào.

Furthermore, Squirrel AI provides a market-tested example of the "human-machine collaborative" model. The company often employs a blended learning model, where the AI system handles the majority of direct instruction—the diagnosis, content delivery, and practice—while a human tutor provides motivational and socio-emotional support.[1] The effectiveness of this model is not merely anecdotal. A randomized controlled trial (RCT) published in an academic journal found that eighth-grade students using the Squirrel AI system achieved significantly greater progress in mathematics tests compared to students in traditional large- or small-class instruction led by experienced teachers.[1] This provides crucial independent evidence for the model's potential efficacy.

5.2 Case Study 2: iFlytek as the Quasi-State Partner

While Squirrel AI has focused heavily on the after-school tutoring market, iFlytek (科大讯飞) represents a different but equally crucial facet of the ecosystem: the large-scale technology provider that partners directly with the public school system.[1] As a "national champion" in voice recognition and AI, iFlytek has developed a suite of solutions, such as its "Smart Classroom" and "AI Study Partner," designed for seamless integration into the state's educational infrastructure.[1] Its systems leverage AI and big data to analyze student performance on homework, quizzes, and exams, generating detailed diagnostic reports for teachers that enable personalized teaching plans.[1]

iFlytek's deep integration with state policy is evident in its corporate reports, which detail the deployment of its products in multiple national-level "Smart Education Demonstration Zones" and Ministry of Education pilot projects.[1] This indicates a role that transcends that of a simple vendor, positioning the company as a quasi-state

partner in policy implementation. While independent research on its specific products is limited, the broader concept of the "Smart Classroom" is supported by academic evidence. A meta-analysis of 21 empirical studies found that smart classrooms have a significant positive impact on student learning outcomes, particularly in cognitive and behavioral development, with an overall effect size (SMD) of 1.10.[1]

Recent studies of Chinese undergraduate students' experiences with generative AI in personalized learning environments provide a nuanced picture that reflects both the promise and the peril of this new paradigm.[1] On one hand, students report significant benefits, finding that AI tools enhance their motivation and dramatically improve their efficiency. Many feel that interacting with AI helps them develop higher-order thinking skills, including creativity and critical analysis.[1] On the other hand, these benefits are counterbalanced by a range of serious concerns, including the risk of over-reliance on AI, issues with the reliability of AI-generated content, and major concerns about data privacy and algorithmic bias.[1]

These cases reveal a powerful symbiotic relationship between China's EdTech industry and its national policy objectives. The state, through its top-down directives, creates and guarantees a massive, predictable market, signaling precisely what kind of innovation is desired.[1] In a typical market economy, companies innovate and then search for a market; in this model, the state's agenda massively de-risks research and development for aligned companies. In response, firms like Squirrel AI and iFlytek develop and refine the specific technologies required to make the state's vision a reality. These technologies are then piloted and scaled within the public education system, generating the data and proof-of-concepts the state needs to validate and advance its policy. This creates a powerful feedback loop where state ambition drives corporate innovation, and corporate technology enables the realization of state ambition. The EdTech ecosystem, therefore, functions as a quasi-extension of the state's research, development, and implementation apparatus, a dynamic that dramatically accelerates the national agenda.

6 The Algorithmic Panopticon: Ethical Risks and the Governance Imperative

While the official narrative surrounding the "AI+" education initiative emphasizes its potential to deliver personalization, efficiency, and equity, a critical analysis reveals a landscape fraught with profound ethical challenges and societal risks. The data-intensive, centrally controlled nature of China's approach, combined with its broader system of governance, creates a unique set of dilemmas that pit the promise of pedagogical innovation against the peril of pervasive control, a dynamic aptly captured by the concept of the "algorithmic panopticon."

6.1 Framing the Risks

The very foundation of large-scale personalized learning, as envisioned by the "AI+" directive, is the mass collection of highly granular student data. The systems being deployed are designed to capture not just correct and incorrect answers, but every hesitation, every mouse movement, and every pattern of interaction, creating an unprecedentedly intimate dataset on the cognitive and behavioral development of an entire generation.[1] This raises critical concerns about data privacy and surveillance. In a governance environment that prioritizes social stability and has a well-documented history of leveraging technology for social monitoring, the risk that this educational data could be used for purposes beyond pedagogy—such as social credit scoring, predictive policing, or political monitoring—is substantial.[1] The creation of a centralized, state-accessible repository of detailed student profiles constitutes a powerful tool of social management, blurring the line between education and surveillance.[1]

A second major risk is algorithmic bias. A central justification for the policy is its promise to "promote education equity".[1] However, the technological means of implementation carry a significant risk of achieving the opposite result. AI models are only as good as the data they are trained on, and if learning models are predominantly trained on data from students in affluent, well-resourced urban centers, they may be less effective for, or even biased against, students in rural provinces, ethnic minority regions, or schools with different pedagogical norms.[1] Instead of closing the educational gap, a poorly implemented AI system could inadvertently codify and amplify existing societal inequalities, creating a high-tech version of the very problem it claims to solve.[1]

Finally, there are direct pedagogical risks for student development. Educators and students alike voice concerns about the potential for "metacognitive laziness".[1] An over-reliance on AI tools to provide answers, structure essays, and solve problems could diminish students' development of essential skills like critical thinking and resilience.[1] Furthermore, the drive for efficiency risks eroding the "human touch" that is fundamental to meaningful education, potentially neglecting the crucial socio-emotional development of children in an overly mechanized learning environment.[1]

6.2 A Governance Toolbox for Institutional Safeguards

The Chinese government is not oblivious to these ethical challenges and has issued a series of official documents outlining ethical frameworks.[1] However, a significant governance gap exists between the articulation of these principles and their practical enforcement. To move beyond critique to a constructive proposal, one can draw on the EU's regulatory framework to build an actionable "governance toolbox" of institutional safeguards that could mitigate these risks:

1. Data Minimization and Purpose Limitation: Based on the EU's GDPR, this principle would mandate that only data strictly necessary for a specific, declared pedagogical purpose be collected. It would require localized storage for minors' data by default and provide users with clear mechanisms to withdraw data authorization.[1]

2. Transparency and Explainability: Inspired by the EU's AI Act, this would require disclosure to teachers and students when an AI system makes a high-stakes decision (e.g., grading or promotion recommendations) and provide a basic, understandable explanation of its logic.[1]

3. Meaningful Human Oversight: This principle, also central to the EU framework, would mandate that a human teacher must review and approve all significant AI-driven recommendations, such as final grades or disciplinary actions. A metric like a "teacher-AI intervention ratio" could be established for critical pedagogical moments to ensure human judgment remains central.[1]

4. Mandatory Risk and Bias Audits: Following the AI Act's requirements for high-risk systems, this would necessitate independent, third-party audits of algorithms for bias and other risks before they are deployed in educational settings, with ongoing monitoring thereafter.[1]

6.3 The Structural Governance Gap

The primary obstacle to implementing such a toolbox in China is a structural conflict of interest. The state, through its various ministries and agencies, is the primary promoter, funder, and beneficiary of the rapid development and deployment of AI. At the same time, it is the sole entity responsible for regulating it.[1] Unlike in systems with robust checks and balances from an independent judiciary, a free press, or vocal civil society organizations, the regulatory and oversight mechanisms in China are internal to the same party-state apparatus that has declared winning the global AI race a paramount national priority.[1]

This creates a structural bias. When a choice must be made between achieving a strategic national goal (rapid AI deployment) and protecting individual rights (data privacy), the system is structurally inclined to favor the former. This is evident in the broad national security exceptions built into China's data privacy laws, such as the Personal Information Protection Law (PIPL).[25] The consistent pattern of leveraging technology for social control, as documented in research on techno-authoritarianism and surveillance, suggests that the state's strategic imperatives will almost always prevail over individual privacy concerns.[27] Therefore, the "governance gap" in China's AI ethics is not an accidental oversight or a sign of an immature system but a predictable feature of a political system that subordinates individual rights to collective state objectives. The core challenge is not a lack of principles, but a lack of independent enforcement mechanisms.

7 Engineering the Future: Workforce Transformation and Global Standard-Setting

The "AI+" education directive is ultimately a long-term economic and geopolitical strategy. Its primary objective is to proactively engineer the human capital base that China will need to thrive in the 21st century. Its success or failure will be measured not just in test scores, but in its ability to transform the nation's workforce, drive productivity growth, and secure a leading position in the global technological order.

7.1 A Long-Horizon Human Capital Investment

The curriculum's shift from "knowledge transmission" to "capability enhancement" is a direct response to the anticipated impact of AI on the future of work.[1] As AI and automation increasingly displace routine cognitive and manual tasks, the demand is shifting towards competencies that are complementary to AI, such as critical thinking, creativity, complex problem-solving, and social-emotional intelligence.[1] The new curriculum is explicitly designed to cultivate these exact capabilities from the earliest stages of education, aiming to produce a generation of workers who do not compete with AI but are adept at leveraging it as a tool.[1]

This educational reform is a direct intervention aimed at ensuring the country has a workforce capable of developing and utilizing new technology, a prerequisite for realizing the significant productivity and GDP growth that widespread AI adoption promises.[1] It is also a critical response to China's pressing demographic challenges. With a rapidly aging population and a shrinking workforce, the country can no longer rely on labor quantity to drive economic growth.[1] Future prosperity will depend on a dramatic increase in the productivity of each individual worker. By embedding AI literacy and higher-order skills throughout the population, the state aims to create a smaller but far more productive workforce, using human capital quality to offset the decline in quantity.[1]

7.2 Global Competitiveness and Standard-Setting

The implications of this strategy extend far beyond China's domestic economy. By systematically cultivating a massive, AI-native talent pool, China aims to build a sustainable, long-term advantage in innovation. This educational pipeline is designed to feed the country's already formidable research and development engine. While the United States still leads in the production of top-tier AI models, data from Stanford University's 2025 AI Index Report shows that the performance gap of Chinese models on key benchmarks is rapidly closing. In 2024, U.S.-based institutions produced 40 notable AI models, significantly outpacing China's 15. However, performance differences on major benchmarks such as MMLU and HumanEval shrank from double digits in 2023 to near parity in 2024. Furthermore, China continues to lead globally in the quantity of AI-related publications and patents.[30]

Data from the World Intellectual Property Organization (WIPO) confirms this trend, reporting that between 2014 and 2023, generative AI patent filings from China exceeded 38,000, six times the number from the U.S., with Chinese firms like Tencent and Baidu ranking among the top global applicants.[1] This complete chain from talent cultivation to innovation output provides China with a powerful tool of soft power. The development of a comprehensive, state-endorsed model for AI education, complete with curricula, platforms, and technologies, creates a product with significant export potential.[1]

The "China's AI Exports Database" (CAIED) tracks the export of Chinese AI systems and infrastructure to countries in the Global South, often through development financing projects like the Belt and Road Initiative (BRI) and its Digital Silk Road (DSR) component.[34] While the database does not yet contain specific case studies of education system exports, the infrastructure is being laid. The DSR facilitates the expansion of broadband networks, 5G, and data centers, which are prerequisites for metaverse education and other advanced EdTech applications.[36] Furthermore, the BRI's Education Action Plan explicitly aims to make China a popular destination for education, cultivate talent, and promote cooperation in running educational institutions, including vocational and technical colleges, with other BRI countries.[38] The export of this mature EdTech solution as part of a "China model" could become a key vector for expanding the country's technological standards and geopolitical influence, challenging the normative power of the US and EU in global governance.[1]

8 Conclusion: The Duality of a New Paradigm

The "AI+" Action directive, and specifically its mandate for educational transformation, represents a watershed moment. It is a clear articulation of a new paradigm of state-engineered pedagogy, where the tools of artificial intelligence are systematically deployed to achieve national strategic objectives. This analysis has deconstructed the policy's architecture, traced its methodical evolution from early pilots to a comprehensive national mandate, and situated it within a comparative global context. It has explored both the tangible applications emerging from China's dynamic EdTech ecosystem and the profound ethical and societal risks that accompany such a data-intensive, centrally controlled system. The conclusion is inescapable: this is a deliberate, comprehensive, and historically-rooted strategy aimed at nothing less than a fundamental re-engineering of society, starting with its youngest citizens. It is a dual-purpose instrument: simultaneously a domestic project aimed at enhancing equity and productivity, and a geopolitical project aimed at securing technological leadership and global influence.

This paper has sought to make four key contributions to the understanding of this phenomenon:

1. Theoretical: Introducing and defining "state-engineered pedagogy" as a new analytical paradigm for understanding state-led technological and educational transformations, moving beyond simple notions of EdTech adoption to a framework centered on statecraft and national strategy.

2. Empirical: Providing a grounded analysis of the policy's implementation through illustrative case studies of leading EdTech firms, substantiated with independent evidence, including randomized controlled trials and meta-analyses, to demonstrate the mechanisms of action.

3. Comparative: Developing a novel framework—the Four-Quadrant Governance Matrix—for mapping and conceptualizing the divergent global governance models for AI in education, highlighting the deep philosophical differences between the state-engineered, market-collaborative, ethics-regulatory, and pragmatic-centralized approaches.

4. Normative: Moving beyond critique to propose a concrete "governance toolbox" of actionable mechanisms (data minimization, transparency, human oversight, and independent audits) benchmarked against international standards to systematically assess and address the profound ethical risks inherent in the model.

The initiative presents a duality of immense promise and significant peril. On one hand, the vision of large-scale personalized learning, if realized, could deliver an unprecedented level of instructional quality and equity, tailoring education to the unique needs of every child and potentially bridging the persistent gap between urban and rural, affluent and disadvantaged. The promise of human-machine collaboration could empower teachers, freeing them from administrative burdens to focus on the deeply human aspects of their profession: mentorship, inspiration, and care. In this optimistic view, the "AI+" directive could catalyze a genuine pedagogical revolution, making learning more engaging, effective, and accessible for all.

On the other hand, the strategy carries the profound risk of creating a system of pervasive surveillance and algorithmic control. The mass collection of granular student data, while necessary for personalization, creates a powerful tool for social management that could extend far beyond the classroom. The potential for algorithmic bias to reinforce existing inequalities and for an over-reliance on technology to diminish critical thinking and human agency is substantial. The core tension of the "AI+" model lies in its fusion of educational goals with the state's overriding priorities of stability, control, and geopolitical competition. The pursuit of a technologically advanced and globally competitive nation could come at the cost of individual privacy, autonomy, and the unquantifiable "human touch" that lies at the heart of true education.

Ultimately, China's "AI+" experiment in education will serve as a global bellwether. As the world's most ambitious and systematic effort to integrate AI into a national education system, its outcomes will be watched and studied for decades to come. Its successes will undoubtedly influence pedagogical norms, technology standards, and policy debates in countries around the world. Its failures will serve as a cautionary tale about the potential pitfalls of techno-authoritarian governance. The central question that China's experiment poses to the world is whether the immense potential of AI-driven education can be harnessed to serve humanistic goals, or whether the logic of efficiency and control will inevitably prevail. The world will be watching to see if this new paradigm of state-engineered pedagogy can deliver on its promises without exacting an unacceptable social and ethical price.

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