International Comparison and Implications of Digital Education Policy Tools: Based on Textual Analysis of Generative Artificial Intelligence Education Policies in China and Europe

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Abstract

This study compares generative artificial intelligence (GenAI) education policies in China and the European Union (EU) using a three-dimensional policy instrument framework and quantitative textual analysis from the dual perspectives of basic policy instruments and application elements. The findings reveal that China adopts a balanced configuration of environmental, supply, and demand instruments, while the EU emphasizes ethical regulation. Both prioritize transforming teaching models and evaluation systems but share a blind spot in teacher workforce capacity building, though China maintains a significant advantage in infrastructure investment. These divergences stem from China's developmental strategic ambition versus the EU's regulatory tradition of digital rights protection. Accordingly, this study proposes three optimization pathways for China's digital education governance: deepening technology-practice integration based on infrastructure advantages, establishing fine-grained standards for educational algorithm admission by learning from precautionary regulations, and systematically advancing teachers' digital literacy and human-machine collaboration to bridge policy gaps.

Keywords

Generative artificial intelligence, digital education, policy tools, text analysis, international comparison.

1. Introduction

Against the backdrop of a new round of technological revolution and industrial transformation, Generative Artificial Intelligence (GenAI) is reshaping every sector of society at an unprecedented pace. Within the education system, this transformation is particularly profound.

In recent years, the policy governance of digital education and artificial intelligence has become a heated topic in academia. Existing research has mainly explored three dimensions: first, macro-level strategies and international trends [1]; second, region-specific analyses, especially in-depth examinations of the EU's value orientation toward "ethical regulation" and "human rights protection"[2]; and third, quantitative comparisons and reflections on application elements through the lens of policy tools. These studies have provided a solid foundation for understanding the global landscape of governance.

However, in light of the reshaping of the educational ecosystem by GenAI, current research still has three notable limitations: first, few studies have conducted a bilateral quantitative comparison between China and the EU; second, there is a lack of a dual-dimensional framework combining "policy tools" and "application elements"; third, most studies remain at the level of textual description, failing to explore the underlying institutional drivers, and often overlook the common shortcoming of "heavy regulation but light attention to the teaching workforce." These gaps represent the academic void that this study aims to fill.

2. Research Design and Analytical Framework

2.1. Sample selection

The representativeness and comparability of policy texts form the foundation of comparative research. In selecting the sample, this study focused on the hierarchical level of issuing authorities, the responsiveness of the documents to recent Generative Artificial Intelligence (GenAI) technologies, and the structural correspondence between macro and micro policies. After systematic review, four core policy documents were identified.

For China, at the macro level, the Opinions on Accelerating the Digitalization of Education (2025), issued by nine departments including the Ministry of Education, was selected[3]. At the micro level, the Guidelines for Teachers on the Application of Generative Artificial Intelligence (First Edition) (2025), released by the Ministry of Education, was chosen[4]. For the European Union, the macro-level document is the *Digital Education Action Plan 2021-2027* (2020) published by the European Commission[5]. The micro-level document is the Guidelines on the Ethical Use of Artificial Intelligence and Data in Teaching and Learning for Educators (2026) [6].

2.2. Analytical framework

The application of Generative Artificial Intelligence (GenAI) in education involves not only technological empowerment but also complex ethical considerations, making a single-perspective policy analysis insufficient to capture its full picture. Accordingly, this study adopts the three-dimensional policy instrument model proposed by Rothwell and Walter Zegveld, integrated with localized theoretical refinements by Chinese scholars, to conduct a coding analysis of GenAI education policies from supply-oriented, environment-oriented, and demand-oriented dimensions. Supply-oriented instruments provide resource inputs, demand-oriented instruments facilitate application scenarios, and environment-oriented instruments focus on regulatory frameworks. Applying this framework to the current study enables a systematic examination of how Chinese and EU governments deploy instrument mixes in response to the GenAI wave. It also allows for a quantitative comparison of their strategic trade-offs between promoting innovation (supply/demand) and mitigating risks (environment), thereby offering solid structural support for understanding the divergent logics of digital education governance.

2.3. Research methods and reliability test

This study primarily employs content analysis. A two-dimensional analytical framework based on Rothwell and Zegveld's policy instrument model is constructed to quantitatively process and structurally code the selected digital education policy samples from China and the EU. Operationally, the three basic policy instruments are disaggregated into nine specific dimensions, each with rigorous operational definitions. The most representative original entries extracted from the four core policy documents serve as coding anchors.

In the specific coding process, two researchers with backgrounds in educational policy studies independently scored and categorized text units based on the operational definitions of the policy instrument typology. For items with coding discrepancies, a third senior expert was invited to participate in discussions and make the final determination. To examine coding reliability, the preliminary coding results of the two researchers were tested for consistency using SPSS software, yielding a Cohen's Kappa coefficient of 0.85. This value significantly exceeds the acceptable threshold of 0.8, indicating that the textual coding data in this study possess adequate objectivity and reliability.

3. Comparative analysis of GenAIeducation policies in China and the EU

Following the theoretical construction and textual coding presented above, this chapter conducts a comparative analysis of GenAI education policies in China and the European Union based on empirical data. The analysis begins by objectively presenting quantitative differences between the two parties in terms of policy instrument preferences and the distribution of educational application elements. Subsequently, it moves beyond surface-level data to explore the deeper institutional factors underlying the divergent governance approaches, taking into account their respective developmental contexts.

3.1. Basic policy instrument preferences

Based on a frequency count of 36 analytical units drawn from the GenAI education policies of China and the EU, this study identifies distinct structural differences in the configuration of basic policy instruments, as shown in Figure 1. For the EU, policy instruments are heavily concentrated in the environment-oriented category (71.4%), while supply-oriented (21.4%) and demand-oriented (7.1%) instruments account for relatively low shares, presenting an unbalanced distribution pattern. In contrast, China's policy texts exhibit a more even distribution across environment-oriented (40.9%), supply-oriented (36.4%), and demand-oriented (22.7%) instruments. Moreover, the combined share of supply- and demand-oriented instruments in China (59.1%) is significantly higher than that of the EU, reflecting a multi-dimensional synergistic structural characteristic.

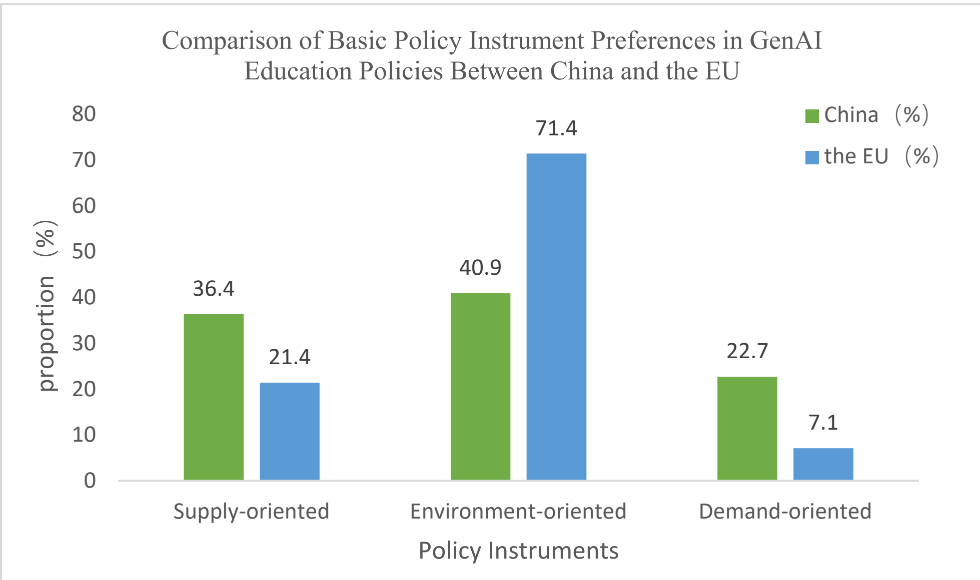

Figure 1. Comparison of Basic Policy Instrument Preferences in GenAI Education Policies

The above data characteristics reflect a deep divergence in digital education governance philosophies between China and the EU. The EU's heavy emphasis on environment-oriented instruments is rooted in its consistent logic of precautionary regulation. Influenced by the risk-based tiered regulatory framework of the AI Act, the EU tends to regard the application of GenAI in education as a high-risk scenario. Consequently, its policy interventions rely primarily on environment-oriented regulatory instruments such as ethical guidelines, data audits, and transparency requirements, aiming to build a robust technological safety net[7]. However, the scarcity of demand-oriented instruments also indirectly indicates that the EU lacks a macro-level pull mechanism for integrating technology into real teaching scenarios, as its governance focus lies in risk prevention rather than technology promotion.

ISSN: 2688-8653

In contrast to the EU's defensive stance, China's balanced distribution of policy instruments reflects an agile governance logic of "balancing development and security." As noted by domestic scholars, China's AI governance emphasizes not only bottom-line regulation but also the role of AI as a strategic engine for structural transformation of the education system. In policy practice, the relatively high proportion of environment-oriented instruments reflects the state's attention to large-model algorithm registration and information security. Meanwhile, the government simultaneously deploys a substantial number of supply-oriented instruments (e.g., investment in computing infrastructure) and demand-oriented instruments (e.g., pilot application zones). This multi-pronged instrument mix aims to provide underlying technological support through visible government intervention, stimulate internal demand within the education system through application demonstrations, and ultimately achieve substantial empowerment of GenAI for digital education transformation under controlled and predictable conditions.

3.2. Comparison of the distribution of educational application elements

A two-dimensional analysis of policy instruments requires not only examining the government's preferred means of intervention (X-axis) but also identifying the specific educational domains on which these instruments act (Y-axis). The frequency distribution of application elements objectively reflects the scope of intervention and the allocation of attention in digital education governance. Through a structural comparison of Chinese and EU policy texts across four major application elements, as shown in Figure 2, this study finds that, in responding to GenAI, both parties exhibit a "cross-national consensus" on core teaching practices, while demonstrating distinct path differences in foundational support systems.

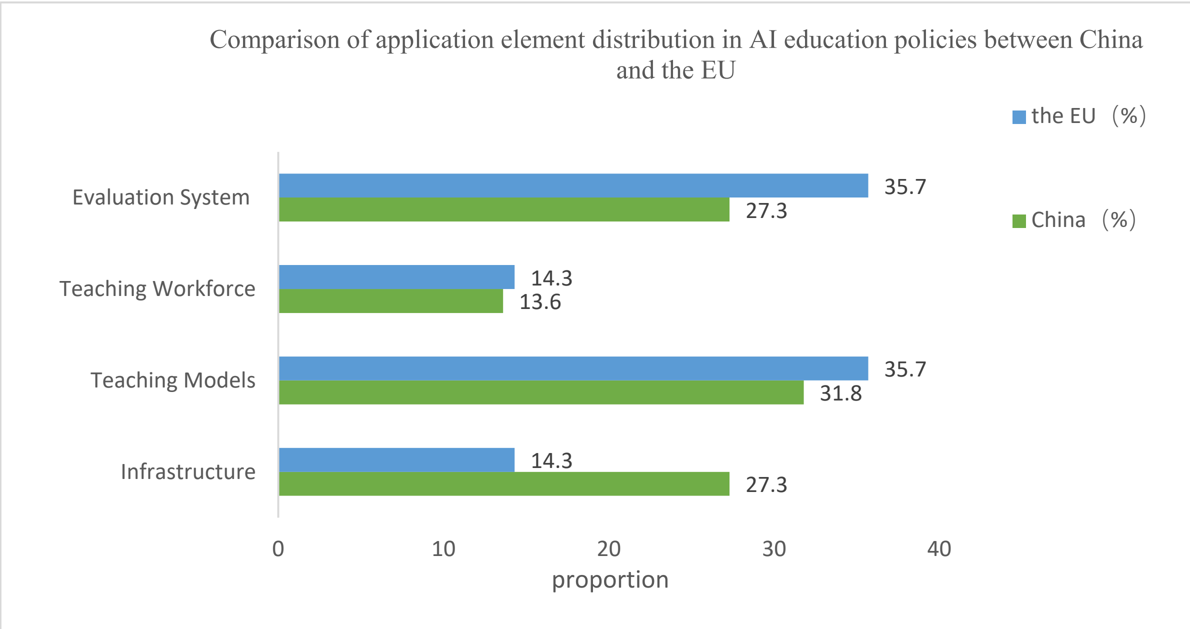

Figure 2. Comparison of application element distribution in AI education policies

First, in core educational scenarios, both China and the EU place strong emphasis on transforming teaching models and evaluation systems. China allocates 31.8% and 27.3% of its policy focus to these two elements, respectively, while the EU assigns its highest shares (35.7%) to the same elements. This similarity stems from the challenges GenAI poses to academic integrity and validity in traditional knowledge transmission and summative assessment. Consequently, China explicitly restricts the use of AI-generated automatic grading as final evaluation criteria, and the EU emphasizes establishing supervision mechanisms to prevent AI misuse. Both sides aim to drive the educational ecosystem from knowledge transmission toward higher-order thinking cultivation.

Second, regarding foundational support, China demonstrates significantly stronger commitment to infrastructure investment (27.3%) than the EU (14.3%). This difference reflects China's context of digital education transformation, where computing power and localized corpora have become core barriers to narrowing the digital divide and breaking data silos. Thus, China prioritizes data centers, computing networks, and multimodal datasets. In contrast, the EU, with its relatively well-established digital infrastructure, focuses policy efforts on ethical review and rights protection, with less direct intervention in underlying technologies.

Finally, both sides show weak policy attention to teaching workforce development—China at 13.6% and the EU at 14.3%, the lowest among all elements. In human-machine collaborative education, teachers are not merely technology users but critical gatekeepers for preventing risks and guiding appropriate AI use. However, current policies on both sides are largely occupied with front-end technical regulations and back-end evaluation oversight, resulting in insufficient support for teachers[8]. The lack of systematic AI literacy training risks exacerbating teachers' technological anxiety—a key area that future digital education governance must urgently address.

3.3. In-depth Analysis of Divergent Governance Logics

The quantitative findings above indicate that, despite facing similar instructional challenges in the application of GenAI to education, China and the EU exhibit notable differences in the configuration of policy instruments and infrastructure investment. This divergence in governance preferences is not accidental but deeply rooted in their distinct strategic development orientations and institutional-cultural traditions.

First, China's comprehensive policy mix and emphasis on infrastructure reflect the strategic catch-up imperative of a "developmental state" and the institutional inertia of a new whole-of-nation system. Within its macro-historical context, the Chinese government has consistently regarded frontier technological innovation as a core engine for bridging development gaps and enhancing national competitiveness. Under this logic, GenAI represents not merely a tool iteration in education but a key arena in national "new infrastructure" and technological self-reliance. Accordingly, the Chinese government acts not only as a regulator but also as an investor and enabler. Leveraging strong resource mobilization and coordination capacities, the state promotes the construction of computing networks and foundational educational large models through direct fiscal investment and project leadership[8]. This governance philosophy of "promoting security through development" significantly shapes China's prioritization of supply- and demand-oriented instruments, aiming to seize the high ground in digital education through technological empowerment, thus exhibiting a proactive policy stance.

Second, the regulatory dominance of EU policies is deeply influenced by its "regulatory state" paradigm and the historical legacy of "digital constitutionalism." Unlike the technology- and industry-driven models of China and the United States, the EU's transnational governance architecture relies heavily on the export of rules and standards, seeking to establish moral anchors for global digital governance through the "Brussels Effect." Reflecting on post-World War II experiences of technological alienation and authoritarianism, the protection of human dignity and fundamental rights is deeply embedded in EU treaty frameworks. In addressing GenAI, the EU naturally invokes the precautionary principle, deeply rooted in its legal tradition, viewing algorithmic opacity as a systemic threat to citizens' digital rights. Particularly in education—a sensitive domain concerning the value formation of minors—the EU inevitably classifies such applications as high-risk, seeking to construct a defensive matrix through intensive ethical review and transparency requirements[9]. This institutional instinct to prioritize fundamental rights over technological expansion leads to a strongly conservative and constraining pattern in policy instrument selection.

In summary, driven by national strategic catch-up goals, China has followed a path of "technological empowerment and infrastructure first" through its whole-of-nation system. In contrast, constrained by the tradition of digital constitutionalism, the EU has followed a path of "rights protection and ethical regulation first" through its normative power[10]. The interaction of these two macro-level narratives constitutes the underlying code for the observed surface-level differences in policy data between China and the EU.

4. Conclusion

Based on quantitative coding and comparative analysis of GenAI education policy texts in China and the European Union, this study systematically reveals the structural characteristics of policy instrument mixes and application element configurations in both parties.

Regarding policy instruments, China and the EU exhibit divergent paths characterized by “coordinated synergy” versus “regulatory dominance.” China demonstrates a balanced distribution of environment-oriented, supply-oriented, and demand-oriented instruments, aiming to integrate safety baselines with technological empowerment, and relying on computing infrastructure construction and application pilots as dual drivers for technology implementation. In contrast, the EU shows a pronounced preference for environment-oriented instruments (71.4%), with its governance logic closely adhering to ethical norms and rights-based approaches, while direct policy intervention in underlying technology R&D and application promotion remains relatively limited.

Regarding application elements, both parties display a combination of convergent core priorities and divergent foundational support. In response to the impact of large language models on traditional educational ecosystems, both identify “teaching models” and “evaluation systems” as core policy intervention areas. However, at the foundational support level, China allocates a significantly higher proportion of policy attention to “infrastructure” (27.3%) than the EU (14.3%), reflecting China’s macro-strategic imperative to bridge the digital divide and consolidate technological foundations. Furthermore, both China and the EU allocate the lowest proportions of policy attention to the “teaching workforce” (13.6% in China and 14.3% in the EU), revealing a structural blind spot prevalent in current digital education governance systems, namely the emphasis on technological regulation at the expense of teacher empowerment.

Based on the empirical comparative findings above, in advancing the application of GenAI in education, China should continue to leverage its institutional advantages while reasonably adopting international experiences in preventive regulation. Drawing on current theoretical discussions in both domestic and international academia, the governance pathway for digital education can be further optimized along the following three dimensions.

First, building on China’s advantage in infrastructure planning, deepen the substantive integration of GenAI with core teaching activities. The previous data indicate that China has a significant policy investment advantage in infrastructure elements such as national data centers and educational corpora (27.3%). However, the fundamental purpose of digital education is not the physical accumulation of technological equipment but the deep coupling of technology with teaching and learning scenarios. As noted in relevant domestic studies, the application of GenAI in education, if detached from concrete teaching practices, can easily degenerate into superficial technology demonstration. Therefore, the future policy focus should shift from “construction-oriented” to “simultaneous construction and application,” further increasing the proportion of demand-oriented policy instruments. Education authorities may establish AI in education pilot zones to effectively channel the already constructed computing networks into core teaching workflows such as after-school tutoring, differentiated instruction, and formative assessment. By leveraging the coordinating advantages of the whole-of-nation system, idle underlying technical infrastructure can be avoided, facilitating a transition from hardware infrastructure construction to the building of an educational service ecosystem.

Second, drawing on preventive regulatory experiences, establish fine-grained standards for educational algorithm review and admission. Data analysis shows that environment-oriented instruments account for an extremely high proportion (71.4%) of EU policies, reflecting their strict prevention of potential technological risks. Currently, China's ethical policies on AI in education largely remain at the level of macro-level registration requirements and principle-based advocacy. Accordingly, it is necessary for China to appropriately adopt international governance approaches based on risk classification, accelerating the transition from macro principles to micro regulation. Specifically, a catalog for admission review of large model products for basic education should be developed, clearly defining the boundaries of data collection on teachers and students, quantitative standards for algorithm bias testing, and mandatory labeling mechanisms for automatically generated content. Through fine-grained rulemaking, a robust safety net for education can be constructed while encouraging technological innovation.

Third, address the policy gap by systematically enhancing teachers' digital literacy and human-machine collaborative capabilities. This study finds that both China and the EU allocate the lowest proportion of policy attention to the teaching workforce (less than 15%), revealing a structural blind spot prevalent in current digital education governance systems. In the process of GenAI reshaping the educational ecosystem, teachers are not merely passive users of new technologies but serve as core gatekeepers in preventing algorithmic bias and guiding students toward responsible innovation. Current education policies must shift their perspective from emphasizing technological regulation to supporting teachers. Policymakers should systematically incorporate GenAI literacy into national teacher training programs and pre-service teacher education curricula, providing specialized skills training including prompt engineering and ethical judgment. Furthermore, at the institutional level, the division of responsibilities and evaluation mechanisms in human-machine collaborative teaching scenarios should be clarified, effectively alleviating teachers' technological anxiety and safeguarding their professional agency and development in the intelligent era.

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ISSN: 2688-8653

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