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Steering Digital Innovation in Higher Education: A Comparative Policy Analysis of China and Kazakhstan

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Abstract

As the driving forces of national innovation systems and knowledge ecosystems (Etzkowitz & Leydesdorff, 2000; Chankseliani & McCowan, 2021; Satalkina & Steiner, 2025), higher education institutions (HEIs) are undergoing significant digitalisation under the direction of state innovation policies. In addition to micro-level technology acceptance, this paper also examines how macro-level policy systems shape the organisation of digital governance and knowledge resources in China and Kazakhstan through a comparative study. We construct a 2D analysis matrix to cross-reference policy instruments (supply, environment and demand) with attributes of digital governance (operation optimisation, resource allocation and quality supervision). Based on in-depth content analysis of the 24 core national policy documents issued from 2015 to 2026, empirical data show a dual pattern of macro-regulatory convergence and structural instrument divergence. Although both countries rely heavily on environment-oriented instruments for macro-level steering and statutory legitimacy (52.7% in China and 60.0% in Kazakhstan),their distribution of supply-side knowledge resources (34.5% vs. 20.0%) and demand-side market stimulation (12.8% vs. 20.0%) is very different. According to the new institutionalism school, the Chinese model is a centralised digital hub coordination system driven by coercive isomorphism, and the Kazakhstani model is an open-regionalist normative and mimetic alignment with the European Higher Education Area (EHEA) combined with statutory organisational autonomy. By exploring how the various macro-policy tools lead to different endogenous organisational tensions, such as digital bureaucratisation and platform fragmentation, this paper investigates the problem of innovation governance in emerging economies and puts forward a new path beyond technological determinism.

JEL Classification: I23; O38

Keywords: Digital governance; Innovation policy instruments; Knowledge ecosystems; Institutional logics; Organizational transformation; China and Kazakhstan

1. Introduction

With the rapid development of the digital economy, big data analysis and generative artificial intelligence have begun to reshape the organisational ecology of global knowledge creation and innovation systems (Strielkowski et al., 2022). As typical knowledge-intensive organisations and the first institutional environments for advanced human capital formation, higher education institutions (HEIs) are undergoing a wave of digitalisation that goes far beyond the simple upgrade of campus hardware (Etzkowitz & Leydesdorff, 2000; Puerta-Sierra et al., 2022; Chankseliani & McCowan, 2021). Rather, digitalisation has developed into a comprehensive organisational and institutional reform that involves the redistribution of authority within the organisation, reengineering of administrative processes, optimisation of knowledge flow, and iteration of public innovation governance paradigms (Dunleavy et al., 2006; Selwyn, 2016; Zawacki-Richter et al., 2019; Farias-Gaytan et al., 2023). At this time, the general plan for the country and relevant policies will also be released. These macro-level texts directly specify the channels for innovation resource allocation, legitimacy requirements and operating scope of the operating-level HEIs in their digital transformation and knowledge governance restructuring.

However, an organized compilation of the existing studies at the intersection of innovation management, organisational studies and higher education policy shows a significant analytical imbalance. Scholarly exploration of educational digitalisation has focused excessively on micro-level behavioural changes, such as the preparedness of teachers for digital use (Moorhouse, 2024), students' interaction with intelligent learning analysis and video observation (Wu et al., 2024; Liang et al., 2027), students' digital literacy and disparities (Lörz et al., 2026), teachers' digital pedagogy strategies (Tanghe et al., 2026), and localised teaching innovations—and has paid insufficient attention to the development logic of macro-institutional innovation policy documents and cross-national comparative governance (Bond et al., 2018). Particular attention is needed to the problems in developing countries with different political and economic systems and at various stages of institutional construction: What are the specific structural preferences of the government in shaping public policy tools for promoting digitalisation and knowledge governance in professional bureaucracies? In the wave of global digital-era governance, how are different countries using their formal policy systems to manage the long-standing conflict between centralised

strategic coordination and the autonomy of grassroots innovation? The above problems are serious theoretical deficiencies in the field of public innovation policy, institutional theory and knowledge governance.

To correct this deficiency, the two cases of China and Kazakhstan will be used to conduct a detailed comparative policy analysis of institutional differences and geopolitical cooperation in the Eurasian region. As a world leader in large-scale deployment of digital infrastructure, China has accumulated rich institutional experience through strong state strategic mobilization, targeted fiscal investment and centralised construction of digital knowledge platforms. Kazakhstan is a typical emerging economy in Central Asia and the first Central Asian country to fully participate in the Bologna Process; therefore, its institutional system is complex, combining the legacy of post-Soviet administrative reform with supranational standards of the European Higher Education Area (EHEA). Based on the two-way comparisons above, the problems in this study are as follows:

1.What are the structural commonalities and quantitative divergences in the selection and configuration of policy instruments for steering higher education digital and knowledge governance between China and Kazakhstan?

2.What underlying institutional logics, organizational isomorphic mechanisms, and evolutionary innovation pathways are reflected in the official policy architectures of the two nations?

The first three are the new contributions to the existing research. First, from the perspectives of theory and methodology, we construct and operationalise an integrated Policy Instruments–Digital Governance Dimensions two-dimensional cross-analytical matrix (Rothwell & Zegveld, 1985; Howlett, Ramesh, & Perl, 2009) to address the problem of descriptive fragmentation in previous qualitative policy studies of knowledge-intensive sectors. Second, in terms of organisational theory, we connect public innovation policy analysis with new institutionalism (DiMaggio & Powell, 1983; Meyer & Rowan, 1977) and incorporate contextual information from domain experts in both Chinese higher education policy and the Ministry of Science and Higher Education of Kazakhstan. Thirdly, by showing how the policy tools of different regions are employed coercively, normatively, or imitatively, and what internal organisational tensions—such as digital bureaucratisation and platform fragmentation—arise from this, this study provides theoretically informed and context-specific references for public sector digital innovation in Eurasia and the Global South.

2. Theoretical Framework

To conduct an in-depth institutional deconstruction of higher education digital governance in China and Kazakhstan, this study integrates the theory of public innovation policy instruments with digital knowledge governance and new institutionalism in organisational studies. Digitalisation is not just a change in technology; it is also a modification of national policies and institutional systems for how states allocate innovation resources, establish organisational legitimacy, and promote structural reforms in universities. Based on the contextual information provided by an interdisciplinary panel of domain experts in Chinese and Kazakhstani higher education policy, a cross-national analytical system has been established to connect macro-level innovation policy design with micro-level organisational behaviour.

2.1 Policy Instruments

Policy instruments are the specific institutional mechanisms, regulatory interventions and resource organisation plans employed by state authorities to achieve the goal of strategic governance. Building on the classic tripartite taxonomy of innovation policy instruments (Rothwell & Zegveld, 1985; Howlett, Ramesh & Perl, 2009), and given the non-profit, knowledge-intensive characteristics of higher education institutions (HEIs), we divide the policy instruments for digital governance into three main categories:

Supply-oriented instruments are the direct top-down provision of state fiscal funds, digital infrastructure, high-performance computing networks, faculty-student digital literacy training and public technical support for the higher education sector. As an external impetus for institutional reform, supply-side policies in China include targeted central fiscal transfers and state-funded construction of national smart education repositories to promptly alleviate grassroots capital shortages and narrow the inter-regional hardware gap.

Environmentally oriented instruments refer to educational policies, tax and fiscal incentives, strategic administrative plans, standards for data security and algorithmic ethics, legal requirements for quality, etc., all of which aim to build an external institutional ecosystem. Institutionalists do not directly provide micro-level resources for the campus; instead, environmental institutions set compliance boundaries and legitimacy expectations to motivate changes in the internal governance system of the university.

Demand-pull instruments: These measures promote grassroots digital transformation and the introduction of new technologies from the outside in through public service procurement, benchmark pilot projects, cross-border educational cooperation and market-oriented cloud-service outsourcing. By building external EdTech market ecosystems and cross-border

academic networks, demand-side tools can reduce the uncertainty costs of exploring new technologies and stimulate endogenous innovation motivation in individual universities.

2.2 Governance Dimensions

Given the special organisational features of universities as knowledge-intensive professional bureaucracies and loosely coupled systems (Meyer & Rowan, 1977), this study does not fall under the narrow category of hardware informatisation for digitalisation. The three main objects of digital governance for higher education are:

Optimisation of operations: This refers to the application of digital workflows and e-governance process reengineering to break down traditional bureaucratic structures, eliminate cross-departmental information silos, and reduce administrative friction and internal institutional transaction costs (Luo et al., 2024).

Resource allocation: Big data analysis and algorithmic scheduling are used to promote the cross-institutional and cross-regional sharing of knowledge resources, achieving dynamic, Pareto-optimal coordination of elite digital curricula, research funds, mentoring, and large-scale scientific instruments (Xiong et al., 2025).

Quality supervision: Reform the traditional system of higher education quality assurance by shifting external government evaluation from periodic, ex-post administrative inspections to in-depth, real-time, data-driven quality monitoring and dynamic accountability (Dabis & Csáki, 2024).

To ensure that our comparative system takes into account the differences among countries, cross-disciplinary experts have been consulted to understand the political-economic environment in each country. Macro-strategies in China, such as "Digital China" and "Education Informatisation 2.0", are transmitted to local universities through vertical administrative directives and targeted fiscal support to build a dual-engine system of state capital and strategic tasks. Top-down transmission has led to strong coercive isomorphism (DiMaggio & Powell, 1983), and all universities have rapidly unified their digital foundations under the National Smart Education Public Service Platform. Conversely, in Kazakhstan, the State Program "Digital Kazakhstan" has led to the development of Eurasian regional integration and alignment with the Bologna Process. Given the limited public fiscal space and external normative pressure for increased international credit mobility under the European Credit Transfer and Accumulation System (ECTS) and European Higher Education Area (EHEA) quality standards, Kazakhstani universities have been granted

expanded institutional autonomy to balance adherence to international digital compliance with local organisational agility through normative and mimetic isomorphism.

2.3 Analytical Matrix

Based on the two theoretical axes mentioned above, we have orthogonally combined the horizontal Policy Instrument Dimension (supply, environment and demand) with the vertical Digital Governance Target Dimension (operations optimisation, resource allocation and quality supervision) to construct a 3x3 cross-analytical matrix (Figure 1). The matrix shows the structure of weights for individual policy tools and governance goals in China and Kazakhstan, as well as the underlying coupling mechanisms of the state's policy system and institutional reform path.

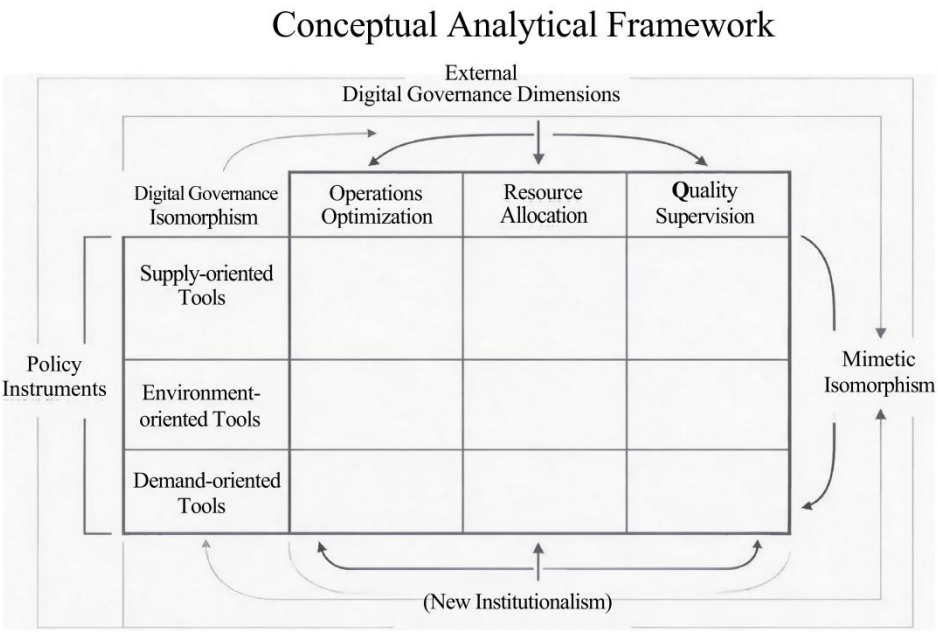


Figure 1: Conceptual Analysis Framework of Higher Education Digital Governance

Note: The 3×3 matrix cross-references policy tools (supply-oriented, environment-oriented and demand-oriented tools) with the target dimensions of digital governance (operational optimization, resource allocation and quality supervision), and embeds the new institutionalistic isomorphism mechanism (compulsory, normative and imitative isomorphism).

3. Research Design and Corpus

This study uses quantitative analysis of policy content and qualitative interpretation of institutions. As an established empirical system for public innovation policy and comparative management research, content analysis can systematically convert unstructured statutory documents into objective, reproducible, and quantifiable scientific evidence to reduce the bias of narrative policy review.

3.1 Corpus Selection

To ensure the authority, symmetry and cross-national comparability of the empirical dataset, policy documents were systematically retrieved from the official state repositories in both countries—including the State Council and Ministry of Education (MOE) portals in China, and the Adilet Legislative Database and Ministry of Science and Higher Education (MSHE) portals in Kazakhstan—based on the three strict screening criteria:

Institutional Authority: The selected materials should be officially issued by first-tier national administrative or legislative organs (e.g., State Council, MOE, Parliament, MSHE), cover national strategic plans, ministerial action blueprints, statutory guidelines and core educational law amendments.

Thematic Relevance: The main regulatory subjects should directly address the digitalisation of higher education, smart campus ecosystems, educational informatisation, construction of digital governance capacity, modernisation of knowledge management, etc., and avoid general administrative notices that only mention digital technology indirectly.

Temporal Symmetry: The observation window is set to 2015-2026, and during this period, both the global and Eurasian higher education systems have undergone significant institutional and governance reforms after the initial wave of foundational hardware deployment. After strict screening and deduplication, we built a symmetric comparison corpus of the 24 landmark national policy documents: 12 in China and 12 in Kazakhstan (see Appendix).

3.2 Coding and Reliability

To improve the accuracy and reliability of the measurement, double-blind coding and cross-validation techniques were employed (Phillips, 2006). First, organise all 24 policy documents into a three-tier structure of (Document ID - Section/Chapter - Semantic Clause), and then identify every complete semantic clause that specifies a particular policy objective and the corresponding governance measures as an independent unit of analysis. Second, the two bilingual researchers independently mapped and coded all the text segments in training for policy analysis into the 3×3 Policy Instruments–Digital Governance matrix.

To correct the initial coding errors, several focus group reconciliation meetings were organised and independent domain experts in Chinese and Kazakhstani higher education policy were invited to conduct third-party blind arbitration and code dictionary calibration. Finally, the 24 policy documents resulted in 200 valid coding units (China: n = 110; Kazakhstan: n = 90). The agreement rate of the two coders was 0.89; therefore, it met the high-reliability requirement of 0.80 for content analysis in management and social sciences.

4. Empirical Results

Systematic coding of the Chinese and Kazakhstani policy corpora has shown significant structural differences in the arrangement and priorities of policy instruments for digital knowledge governance. Table 1 presents the frequency and percentage distribution of the 3x3 analysis matrix cross-coding (Kappa = 0.89), while Figure 2 illustrates the comparative distribution of policy tools between the two countries.

Table 1: Comparative Two-Dimensional Cross-Coding Frequency and Percentage Distribution of Higher Education Digital Governance Policy Texts in China and Kazakhstan

Policy Instrument	Governance Dimension	China n (%)	Kazakhstan n (%)
Supply Tools	Subtotal	38 (34.5%)	18 (20.0%)
Supply Tools	Operations Optimization	10 (9.1%)	4 (4.4%)
Supply Tools	Resource Allocation	20 (18.2%)	8 (8.9%)
Supply Tools	Quality Supervision	8 (7.3%)	6 (6.7%)
Environment Tools	Subtotal	58 (52.7%)	54 (60.0%)
Environment Tools	Operations Optimization	18 (16.4%)	16 (17.8%)
Environment Tools	Resource Allocation	16 (14.5%)	18 (20.0%)
Environment Tools	Quality Supervision	24 (21.8%)	20 (22.2%)
Demand Tools	Subtotal	14 (12.8%)	18 (20.0%)
Demand Tools	Operations Optimization	4 (3.6%)	6 (6.7%)

Policy Instrument	Governance Dimension	China n (%)	Kazakhstan n (%)
Demand Tools	Resource Allocation	6 (5.5%)	8 (8.9%)
Demand Tools	Quality Supervision	4 (3.6%)	4 (4.4%)
Total Corpus	All Dimensions	110 (100.0%)	90 (100.0%)

(Note: Values represent coded policy segment frequencies and within-country percentages.)

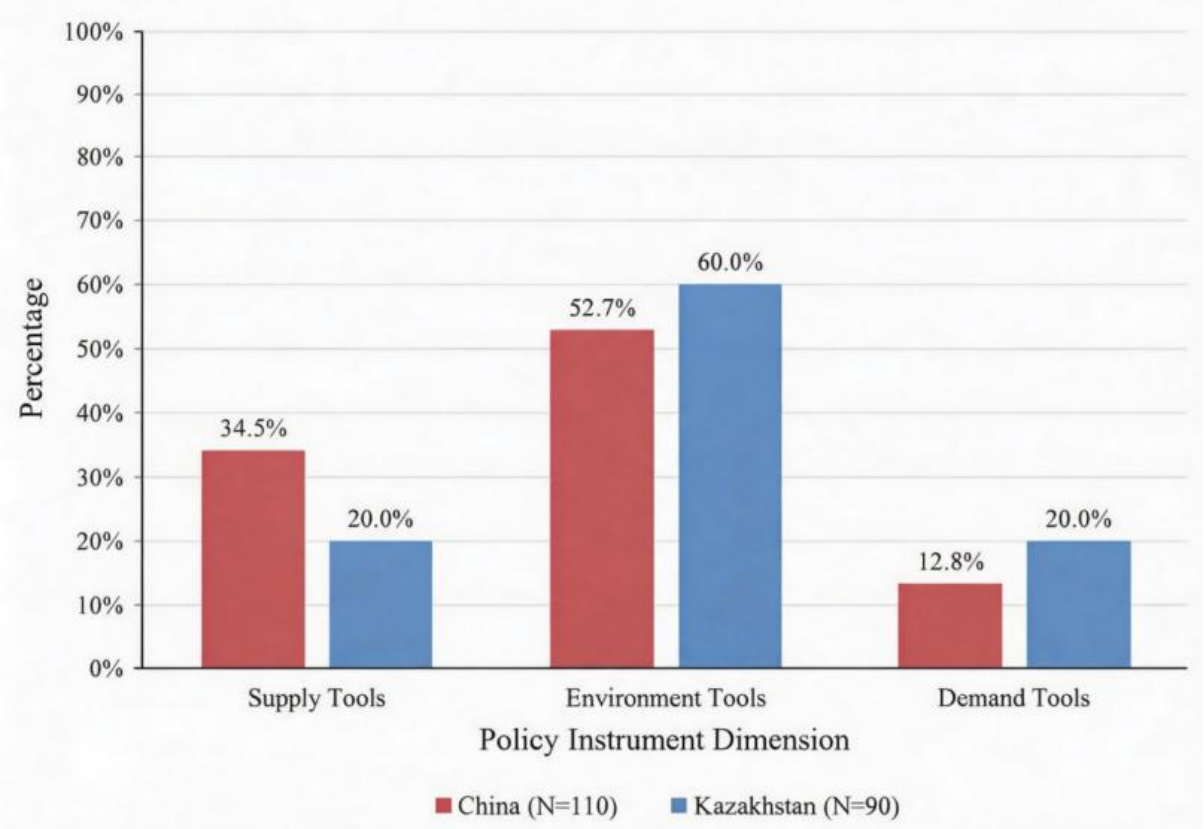


Figure 2 Comparative distribution of policy tools between China and Kazakhstan

Note: This figure shows the percentage distribution comparison of policy tools (supply-oriented, environment-oriented and demand-oriented tools) adopted by China and Kazakhstan in higher education digital governance policies, of which the sample size of China is 110 (N = 110) and the sample size of Kazakhstan is 90 (N = 90)

4.1 Structural Divergence

As shown in Table 1, the innovation policy portfolios of China and Kazakhstan have undergone macro-regulatory convergence but are structurally different. At the macro level, both governments have mainly employed environment-oriented policy instruments to guide their actions and accounted for 52.7% in China and 60.0% in Kazakhstan. Among them,

Full-process Quality Supervision is the largest cell in the entire matrix for both countries (21.8% in China and 22.2% in Kazakhstan). The above convergence shows that, despite differences in political-economic systems, both countries have viewed the digitalisation of higher education not as an organic development of campus technology, but as a top-down institutional reconstruction project led by national strategies, unified data standards, and statutory quality accountability.

Despite the joint reliance on macro-environmental regulation, there are considerable differences in the application of supply-side and demand-side tools:

A two-proportion Z-test and chi-square analysis confirm that China's deployment of supply-oriented policy instruments (34.5%, n = 38) is statistically significantly higher than that of Kazakhstan (20.0%, n = 18), exceeding it by 14.5 percentage points ($Z = 2.28$, $\chi^2 = 5.19$, $p = 0.023$). Cell-level inspection shows that the main reasons for this gap are Supply-side Resource Allocation (18.2% in China vs. 8.9% in Kazakhstan) and Supply-side Operations Optimisation (9.1% vs. 4.4%). The above results show that China's digital knowledge governance is mainly supported by direct investment from the government and top-down public goods construction. Chinese policy documents are full of requirements for central-local earmarked fiscal transfers, state-funded construction of the National Smart Education Public Service Platform, dedicated educational computing networks, and nationwide deployment of digital infrastructure to build the material foundation for institutional reform.

Kazakhstan's Demand-Pulling: Due to a relatively limited public fiscal capacity for direct hardware subsidies, Kazakhstan has been forced to rely more heavily on environment-oriented regulations and demand-oriented instruments (20.0%, compared with 12.8% in China). Within the environmental category, Kazakhstan allocates 20.0% of its coded provisions to regulatory frameworks governing resource allocation and 17.8% to operations optimisation. Kazakhstan has also led China in both resource allocation (8.9% vs. 5.5%) and operational optimisation (6.7% vs. 3.6%) for the demand-oriented row. Qualitative decoding shows that the policy system of Kazakhstan often uses external institutional alignment by referring to the Bologna Process, ECTS digital credit mobility, EHEA regulatory harmonisation, transnational joint-degree platforms and public-private cloud procurement. Instead of constructing a single-state-owned hardware monopoly, Kazakhstan has used supra-national regulatory norms and market-driven demand to promote the modernisation of domestic university governance.

4.2 Path Differentiation

A vertical aggregation of the coding frequencies for the three governance dimensions shows that China and Kazakhstan have almost the same aggregate weights for Resource Allocation (38.2% vs. 37.8%), Quality Supervision (32.7% vs. 33.3%), and Operations Optimization (29.1% vs. 28.9%), but the instrumental paths to mobilize these dimensions are fundamentally different.

Centralised Hub Coordination: In China, the allocation of knowledge resources and quality supervision are driven by a close cooperation between the state and administration. In line with the concept of whole-of-nation governance, Chinese policy documents have called for unified national metadata standards and institutional connectivity of ministerial digital hubs, such as the National Smart Education Public Service Platform and the Higher Education Quality Monitoring National Data Platform. Through this centralised architecture, the government will break down the information silos of the provinces and campuses to implement algorithmic supervision and large-scale cross-regional redistribution of elite teaching and research resources.

Decentralized organizational flexibility: Kazakhstan does not rely on direct national supply, but mainly mobilizes resource allocation and operational optimization by building a regulatory framework and cooperating with demand-side external incentives. Based on legislative reforms, specifically the 2018 Amendments to the Law on Education (Law No. 171-VI), which granted public universities substantive autonomy in academic, human resource and financial management, Kazakhstan does not use a single state-monopolised instructional platform. Instead, the Ministry of Science and Higher Education will use flexible digital reporting interfaces connected to the national e-Gov system and EHEA-compliant accreditation standards to enable individual universities to autonomously purchase commercial learning management systems (such as Platonus or Univer) and build international digital alliances. This way will strengthen the adaptability and institutional stability of the transitional Eurasian knowledge system.

5. Discussion

Based on the empirical distributions in Section 4, this paper integrates New Institutionalism in Organization Theory (DiMaggio & Powell, 1983; Meyer & Rowan, 1977) and Organizational Ecology (Hannan & Freeman, 1984) to develop a theory of the institutional logic differences for China and Kazakhstan. We will also study the particular

structural problems and governance risks at the university level caused by the macro-level policy package.

5.1 The Chinese Path

The development path of higher education digital governance in China is situated within a macro-institutional system of strong state-building and centralised fiscal mobilization, and has been profoundly shaped by policy documents promoting high-level talent cultivation (Bian, 2025). Tracing the evolution of China's policy corpus, from the Ten-Year Development Plan for Education Informatisation (2011-2020) and the Education Informatisation 2.0 Action Plan (2018) to the National Digital Education Strategy Action initiated in 2022, shows a shift from basic network construction to deep organisational integration via a centralised state digital hub.

According to new institutionalism (DiMaggio & Powell, 1983), China's archetype of holistic coordination, centralised platform integration and state resource aggregation function as a typical mechanism of coercive isomorphism. Due to the large proportion of central and provincial ministry support for earmarked funds and student quotas in Chinese public universities, the "Double First-Class" disciplinary accreditation and administrative legitimacy are bound by national policy directives. Link the allocation of supply-side resources to strict adherence to national data standards and environmental quality supervision, and thus compel geographically dispersed universities to rapidly build homogeneous digital architectures and standardised administrative workflows. This coercive isomorphic push produces extraordinary mobilisation efficiency to rapidly build digital infrastructure in the eastern and western regions and drives corporate ESG and regional innovation performance through the application of artificial intelligence (Song et al., 2025; He et al., 2026).

However, according to loosely coupled systems theory (Meyer & Rowan, 1977) and structural inertia theory (Hannan & Freeman, 1984), when intensive top-down administrative digitalisation is applied to universities, which are inherently knowledge-intensive professional bureaucracies relying on academic discretion, serious institutional pressures and endogenous organisational tensions will inevitably arise. From the perspective of institutional design, too much top-down environmental supervision and rigid supply-side standardisation can lead to the structural problem of digital bureaucratisation (digital formalism) at the grassroots level in implementation. At the junction of macro-level data collection and multi-tier bureaucratic accountability, operating-level colleges and faculty face the risk of fragmented data portals, repetitive form-filling, digital worker stress (Bullini Orlandi et al., 2024), AI-enabled HR compliance pressure (Zhang & Liu, 2026), and high-frequency

algorithmic performance audits. The burden of administrative compliance will increase internal transaction costs and may lead to digital fatigue, thus reducing time for academic research and teaching innovation. Due to the conflict between standardised platform indicators and local academic habits, the grassroots department has engaged in symbolic conformity and institutional decoupling (Meyer & Rowan, 1977)—formally submitted standardised data to the national monitoring centre for external validation without changing the long-standing organisational inertia in core academic activities.

5.2 The Kazakhstani Path

In contrast, the institutional logic for higher education digitalisation in Kazakhstan is based on its geopolitical position as a key emerging economy of Eurasia, its post-Soviet administrative reforms, and its active participation in supra-national educational systems, such as state scholarship systems for social mobility (Jonbekova, 2024). As the first Central Asian country to sign the Bologna Declaration and a full member of the EHEA, Kazakhstan's main policy tools—including the State Program "Digital Kazakhstan" (2018-2022), Law No. 171-VI (2018) expanding academic and managerial autonomy, and the Concept for the Development of Science and Higher Education (2023-2029)—prioritize the alignment of transnational standards with domestic administrative decentralisation.

At the level of organisation (DiMaggio & Powell, 1983), Kazakhstan's development has been led by normative and mimetic isomorphism aimed at open regionalism. Instead of a large-scale state-capital supply, the government of Kazakhstan has employed environmental policy tools and demand-side incentives to introduce foreign professional norms in domestic universities. In line with the quality assurance system of the EHEA, credit mobility will be digitised via ECTS, and to enhance the international recognition of Kazakhstani HEIs, they will adopt the digital governance model of top European and foreign universities. As recently reported by Aypay et al. (2026), regional universities in Kazakhstan are also striving for organisational identity under the conditions of symbolic autonomy and structural resource constraints.

Given the fiscal constraints of a transitional economy, the government of Kazakhstan has opted not to build a single state-funded digital monopoly and has instead promoted organisational agility and alliance-based innovation (Yin & Wu, 2026). According to Law No. 171-VI, public universities have been converted into autonomous non-profit joint-stock companies with boards of directors responsible for curriculum design, personnel recruitment, financial budgeting, delegation of power, and procurement of digital technology. The synthesis of supranational normative alignment and statutory devolution fosters institutional

resilience, and thus universities can flexibly use lightweight commercial governance software and international cloud platforms according to their actual needs. However, at the macro level, this decentralized policy system has introduced its own system risk; in the absence of strong central fiscal equalisation and a unified national digital backbone, autonomous market-driven digitalisation will likely exacerbate inter-institutional stratification (the Matthew effect). Although the flagship national universities in Almaty and Astana have formed an EHEA for digital integration through international cooperation, regional institutions are resource-constrained, and the uncoordinated procurement of various commercial platforms has created a structural risk of nationwide data fragmentation.

5.3 Theoretical Implications

A comparative synthesis of the Chinese and Kazakhstani trajectories shows that cross-national divergence in higher education digital governance is not limited to the selection of technical software but represents a structural projection of macro-level state institutional logics onto the organisational field of knowledge-intensive institutions. The Chinese model is a state-corporatist logic of intensive resource empowerment and bureaucratic integration, which has expanded the system's scale and infrastructure equity through coercive isomorphism, but has also created structural risks of grassroots digital bureaucratisation and decoupling. Conversely, the Kazakhstani model is an open-regionalist logic of supranational normative alignment and decentralized agile restructuring, which, through normative and mimetic isomorphism along with statutory autonomy, promotes institutional resilience under fiscal constraints to address inter-institutional disparity and platform fragmentation.

Theoretically, this bilateral comparison challenges the idea of one-way technological determinism in innovation research and is consistent with actor-network theory (Whittle & Spicer, 2008), sustainable digital-servitization frameworks (Lee et al., 2024; Caiado et al., 2024), generative AI entrepreneurship dynamics (Li et al., 2025), and global AI attention studies (SenGupta, 2027). It proposes that the digital transformation of public and knowledge-intensive organisations is a sociomaterial process of mutual construction among digital artefacts, state innovation policy architectures, and university organisational structures, and indicates that the deployment of AI alone cannot improve organisational performance without proper governance (Lelescu et al., 2025). Good knowledge governance should be in line with the political economy, administrative culture and position in the world's innovation system of the country.

6. Conclusions

6.1 Conclusion

Beyond the traditional model of micro-behavioral technology acceptance, a two-dimensional Policy Instruments–Digital Governance analytical matrix was built, and new institutionalism was applied to decode the 24 core national policy documents released by China and Kazakhstan between 2015 and 2026. As shown in the above results:

Macro-regulatory convergence and instrument divergence: Both China and Kazakhstan have introduced environment-oriented policy tools to improve statutory legitimacy and the quality of full-process supervision, but there are considerable differences in resource mobilization; China has favoured state-led supply-side instruments, while Kazakhstan has paid more attention to demand-side instruments and external regulatory alignment.

Bifurcated evolutionary governance pathways: China has been centrally coordinated by a national digital hub and advanced infrastructure construction through state-capital cooperation via coercive isomorphism; Kazakhstan, on the other hand, has been guided by supranational norms of the EHEA and implemented domestic administrative decentralization through normative and mimetic isomorphism.

Endogenous organisational tensions: Both policy systems have created different structural problems at the university level—in China, it is the risk of grassroots digital bureaucratisation, digital fatigue and symbolic decoupling under intense administrative supervision; in Kazakhstan, it is the potential for inter-institutional digital stratification and cross-campus data fragmentation due to decentralized procurement.

6.2 Policy Implications

To reduce institutional friction between the design of macro-level digital policies and micro-level organisational innovation, we put forward specific policy recommendations for China, Kazakhstan and other emerging economies:

For China, in building the national computing network and the National Smart Education Public Service Platform, policymakers need to reduce the risks of digital bureaucratization and compliance fatigue for frontline teachers proactively. The future policy portfolio will reduce the scale of hardware supply and high-frequency administrative data extraction to promote grassroots academic autonomy and introduce unobtrusive, human-AI collaborative quality supervision. Educational authorities can implement a strict "one-form-only" policy for single-entry data sharing and maintain a negative list of administrative assessments to prevent duplicate digital reports. Additionally, the national digital platform will provide access to the underlying analytical computing power and

anonymised data interface for individual universities and researchers to promote substantive knowledge innovation through digital governance.

For Kazakhstan and Eurasia: Given the limitations of finite public funds and regional disparities, they should avoid replicating capital-intensive, state-monopolized hardware construction and instead develop a smart governance strategy based on interoperable national data hubs and cross-border knowledge sharing. At home, in line with the statutory managerial autonomy provided by Law No. 171-VI, the Ministry of Science and Education will issue mandatory national metadata interoperability protocols to enable seamless connection between various campus LMS platforms and the national e-Government portal and the ECTS digital credit repository. Kazakhstan can use multilateral innovation systems, such as the Belt and Road Initiative, the Eurasian Economic Union (EAEU), and the Shanghai Cooperation Organisation University (USCO), to jointly build cross-border educational computing hubs and multilingual open courseware alliances, reduce the burden on domestic finances, and avoid a secondary digital divide for regional universities.

For the Global South: Policymakers in the transitional economies of the knowledge ecosystem modernisation should be aware that simply acquiring commercial software or building a national portal does not constitute governance reform. Governments need to build a harmonious and cooperative system of environmental regulations, basic supply support, and grassroots demand stimulation, and at the same time strengthen bureaucratic process reengineering, academic autonomy, and institutional resilience through technological investment.

6.3 Limitations and Future Research

Although this study has contributed to the field of comparative research on digital governance by building a symmetric cross-national policy corpus and a two-dimensional coding matrix, three methodological limitations have been identified for future research:

Micro-level implementation unpacking: As the main content of the official macro-policy text is generally the government's goals and institutional arrangement rather than the actual situation in schools, the organisational tensions mentioned above (e.g., symbolic decoupling and digital stratification) are theoretically derived structural risks. In the future, several case field ethnographies, large-scale faculty surveys, and semi-structured interviews with university leaders and faculty in both China and Kazakhstan will be conducted to empirically study how macro-digital mandates are implemented or deviated from in daily academic life.

Longitudinal Configurational Analysis: Future research can expand the comparison sample to Central Asia, ASEAN and other developing countries. Combine multi-wave

longitudinal panel data with fuzzy-set Qualitative Comparative Analysis (fsQCA) to conduct a quantitative examination of the time-lagged effects of different policy instrument configurations on university research productivity, knowledge transfer efficiency and international credit mobility.

Algorithmic Governance and Generative AI: With the rapid integration of large language models (LLMs) and generative artificial intelligence into university instruction, academic evaluation, and administrative decision-making, future scholarship needs to explore how the triadic interaction among faculty, students, and AI agents is changing knowledge creation, supervision of research integrity, and professional autonomy.

Declarations

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Appendix / Primary Policy Documents (Corpus for Content Analysis)

Part I: Chinese National Policy Documents (2015–2026)

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