Comparative analysis of Physical Education management models in Chinese and Kazakhstani universities

Análisis comparativo de los modelos de gestión de la Educación Física en universidades chinas y kazajas

Authors

Jiuyang Wang [1]
Tolegenuly Nurzhan [2*]

[1, 2*] ABAI Kazakh National Pedagogical University, Almaty, Kazakhstan,

Corresponding author:
Tolegenuly Nurzhan,
nurzhan_tolegenu@mail.ru

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Abstract

Introduction: The management of physical education in universities has expanded beyond traditional course delivery to include digital monitoring, quality assurance, and internationalization systems. China and Kazakhstan, despite geographical proximity and cooperation under the Belt and Road Initiative, exhibit distinct governance structures in physical education systems.
Objective: The study aimed to develop and apply a Governance-Technology-Pedagogy (GTP) model to systematically compare physical education teaching and training management in Chinese and Kazakhstani universities across governance, curriculum-technology integration, assessment systems, and internationalization strategies.
Methodology: A qualitative comparative case study was conducted involving twelve universities, with six institutions selected from each country. National policy documents, institutional curricula, and bilateral cooperation agreements from 2020 to 2025 were analyzed using thematic comparative analysis guided by norm localization theory.
Results: The findings indicated that China implemented a centralized and artificial intelligence-based system with algorithmic accuracy exceeding 97.5%, a compulsory national fitness examination framework, and inbound mobility exceeding 18,000 Central Asian students. In contrast, Kazakhstan adopted a hybrid-adaptive model characterized by trilingual education policies, competency-based frameworks aligned with the European Credit Transfer System, portfolio-based assessments, and diversified outbound mobility strategies.
Discussion: These models reflected localized adaptations of global educational trends. China's strong governance-technology alignment enabled efficient standardization but constrained pedagogical flexibility, whereas Kazakhstan's model enhanced cultural responsiveness but faced coordination challenges due to its hybrid structure.
Conclusions: The study concludes that both systems represent context-specific adaptations of global physical education governance, and the GTP framework underpins evidence-based educational cooperation for the BRI.

Keywords

AI in education; belt and road initiative; comparative education; educational governance; physical education management.

Resumen

Introducción: La gestión de la educación física en las universidades se ha expandido más allá de la impartición tradicional de cursos para incluir sistemas de monitoreo digital, aseguramiento de la calidad y estrategias de internacionalización. China y Kazajistán, a pesar de su proximidad geográfica y cooperación en el marco de la Iniciativa de la Franja y la Ruta, exhiben estructuras de gobernanza distintas en sus sistemas de educación física.
Objetivo: El estudio tuvo como objetivo desarrollar y aplicar un modelo de Gobernanza-Tecnología-Pedagogía para comparar sistemáticamente la gestión de la enseñanza y el entrenamiento de la educación física en universidades chinas y kazajas en las dimensiones de gobernanza, integración curricular-tecnológica, sistemas de evaluación y estrategias de internacionalización.
Metodología: Se realizó un estudio de caso comparativo cualitativo en doce universidades, con seis instituciones seleccionadas de cada país. Se analizaron documentos de política nacional, planes de estudio institucionales y acuerdos de cooperación bilateral desde 2020 hasta 2025 mediante análisis temático comparativo guiado por la teoría de localización de normas.
Resultados: Los hallazgos indicaron que China implementó un sistema centralizado basado en inteligencia artificial con una precisión algorítmica superior al 97.5%, un marco obligatorio de examen nacional de aptitud física y una movilidad entrante que supera los 18,000 estudiantes de Asia Central. En contraste, Kazajistán adoptó un modelo híbrido-adaptativo caracterizado por políticas de educación trilingüe, marcos basados en competencias alineados con el Sistema Europeo de Transferencia de Créditos, evaluaciones basadas en portafolios y estrategias de movilidad saliente diversificadas.
Discusión: Estos modelos reflejaron adaptaciones localizadas de las tendencias educativas globales. La fuerte alineación entre gobernanza y tecnología en China permitió una estandarización eficiente pero limitó la flexibilidad pedagógica, mientras que el modelo de Kazajistán mejoró la capacidad de respuesta cultural pero enfrentó desafíos de coordinación debido a su estructura híbrida.
Conclusiones: El estudio concluye que ambos sistemas representan adaptaciones contextuales específicas de la gobernanza global de la educación física, y el marco de Gobernanza-Tecnología-Pedagogía ofrece una base sólida para la cooperación educativa basada en evidencia en el contexto de la Iniciativa de la Franja y la Ruta.

Palabras clave

Iniciativa de la franja y la ruta; educación comparada; gobernanza educativa; inteligencia artificial en la educación; gestión de la educación física.

Introduction

Colleges are now playing a strategic position in addressing the issue of physical inactivity at the population level because the shift to higher education has been variously associated with the reduction of structured physical movement, increased screen time, and the adoption of more sedentary lifestyles. Globally, 81 percent of all adolescents between 11-17 years old do not meet the suggested physical activity recommendations, and about one-third of adults are also unproductively active, which is a long-standing program-health and education issue that is present in universities. Therefore, physical education (PE) administration goes beyond timeframes and course delivery to include quality assurance, online surveillance, and governance of the institution. The existing empirical studies of school-university pipelines prove that modalities of teaching, instructional contexts, and patterns of student participation are extremely dependent on institutional organization and teacher practice, which supports the idea that PE outcomes significantly rely on management models (Yan et al., 2024). On the same note, digital technologies are implemented to impact the PE cultures and attitudes of students but the impact will be dependent on the design of the implementation and the capacity to instruct (Ospankulov et al., 2023). These demands are consistent with larger-scale reforms of smart university in Kazakhstan that focus on the system-wide integration of digital governance and management, which in turn influences the administration and evaluation of PE systems (Seitbatkalova et al., 2023).

China and Kazakhstan offer an analytically useful case study within the context of Eurasia since both systems are addressing similar global demands, such as digital change, health promotion, and internationalization, but operationalise PE governance through different institutional logics. The Chinese strategy supports centralized direction, institutional quality management systems, and curriculum-setting of PE specialist training and course delivery (Zhang and Diao, n.d.). Recent research on the Chinese universities follows the systematic transformation of PE specialist training patterns, such as technology-enhanced evaluation and professional growth routes within institutional management systems (Tang, 2024). On the pedagogical level, observational data concerning both the instructional environment and modes of activity demonstrates that the conditions of implementation, including the organisation of the lesson, the spatial arrangement, and the choice of activities, influence student experiences and can promote inequities in the event that governance focuses on conformational rather than situation-sensitive concerns (Yan et al., 2024). In that respect, one of the core problems of China is not only the scaling of PE reforms but also the fact that technology integration and quality management processes are educationally viable in various institutions (Zhang & Diao, 2023).

Kazakhstan, in its turn, can be characterized by the post-Soviet reform path when the forces of modernization collide with the legacies of the past administration and foreign-based norms. In 2010, Kazakhstan became a full Member of the European Higher Education Area as it participated in the Bologna Process which hastened credit-based structures and international comparability and added implementation tensions characteristic of post-Soviet teacher education reforms (Menter, 2024). In PE, the forms of the organisation that have been included in the institutional practice are like club-based physical training systems that reconfigure the participation, continuity of training, and student engagement in the educational institutions (Doskarayev et al., 2023). At the same time, Kazakhstan faces the problem of human-resource and well-being limitations: PE teachers report that burnout and resilience are the relevant aspects of implementation that directly influence the quality of instruction and the sustainability of the programme (Yerezhepov et al., 2025). Digitalisation also spreads in the systems of Kazakhstani education and PE classes, but it is an uneven process and leads to the emergence of the same capacity and infrastructure issues. Collectively, the major challenges facing Kazakhstan are a consistent level of coordination, sustainable capacity of teachers, and a consistent quality assurance of institutions that are heterogeneous, without introducing a discrepancy in reforms (Yerezhepov et al., 2025).

The rationale of this paper is the increasing gap between macro-level international education programs and micro-level discipline application especially in physical education (Yang, 2025). Despite the fact that the Belt and Road Initiative (BRI) has expanded the scope of cooperation between China and Kazakhstan, little consideration has been given to how the specialised areas like PE are regulated, controlled, and transformed in the context of such partnerships. Additionally, the discussions around the topics of digitalisation, standardisation, and institutional autonomy in PE management demonstrate that comparative, evidence-based understanding beyond the Western models is necessary. Therefore, the need to

further the comparative PE scholarship, facilitate policy formulation in contexts, and add a transferable analytical framework that can inform PE management changes in transitional higher education systems informed the study.

Even though the literature on physical education governance and education reform and internationalization activities by Belt and Road Initiative have grown over the recent years, there are still a number of critical gaps that are not adequately addressed. The literature is mostly centered on the analysis of single countries or cross-country comparisons in the Western world, thus neglecting cross-national relationships in non-Western areas, such as between China and Kazakhstan (Wang et al., 2024). Empirical research studies of physical education management in the two countries are still few with most studies focusing on policy making as opposed to looking at implementation processes at institutional level. Moreover, the previous research has been inclined to examine the system of governance, digital technologies, curriculum reform, and internationalization strategies as separate areas, which led to the disjointed knowledge of physical education systems at university level (Zharkynbekova et al., 2024). Moreover, Belt and Road Initiative studies in higher education have been focused on mobility of students and diplomatic relations, but studies have focused on discipline-related issues like physical education, where governance and management practices have direct impact on student health outcomes and development of professional training (Omarov et al., 2024). Thus, it becomes apparent that a unified, comparative approach to the study, which would organize the study of these interrelated dimensions in the framework of China-Kazakhstan cooperation, is required.

With China and Kazakhstan enhancing their education collaboration in the BRI as they follow different reform paths, the absence of comparative data on the application of their PE managerial paradigms poses a threat to policy learning and institutional cooperation. The present study fills this gap by offering a brief, combined comparative analysis of PE teaching and training management in both countries, the role of the difference in the governance, the use of technology, and pedagogy in the determination of the results of implementation, and the information about future reform and collaboration (Amirbekova et al., 2025).

The main aim of the research is to comparatively examine the application of the models of teaching and training management of physical education (PE) in Chinese and Kazakhstani universities. In particular, the research will seek to:

1) Investigate variations in the governance structures and the policy localisation processes that determine PE management in centralised and hybrid systems;
2) Examine the differences in curriculum models and pedagogical technology adoption, especially AI-based in China and modular, trilingual in Kazakhstan;
3) Compare the assessment and quality assurance systems, such as national fitness testing and the competency evaluation according to ECTS; and
4) Test the impact of internationalisation strategies of the Belt and Road Initiative era on PE management practices and transnational cooperation.

The value of this research is that it dwells upon physical education management in the growing China–Kazakhstan educational collaboration in the Belt and Road Initiative that is characterized by over 20 bilateral university agreements between 2023 and 2025 in the fields of artificial intelligence, dual-degree programmes, and educational technology. The creation of academic institutions like the Beijing Language and Culture University Kazakhstan Branch and the Kazakh-Chinese Scientific and Technological Alliance on Spatio-Temporal Artificial Intelligence is an indication that there is a need to understand pedagogical and managerial alignment systematically across national systems. This paper is a multi-dimensional, implementation-oriented, new comparison of PE management models outside of Western-centric models, which incorporates governance, technology, pedagogy and internationalisation in offering original information to comparative physical education research and policy-making.

Literature review

Conceptual and Governance Frameworks For Comparative Pe Management

Pre-existing literature defined the administration of physical education (PE) in higher education as a discipline that greatly depends on governance, where policy formulation, administrative coordination, and pedagogical implementation have a complex and multi-level interaction. It was established by (Valiyev et al., 2025) that the effectiveness of PE policy implementation depends on hierarchical organization of planning, inter-ministerial coordination, and systematic monitoring of performance, and at the same time, bureaucratic inflexibility is identified as the main barrier that requires adaptive governance. (Madsen, 2022) suggested hybrid governance systems in which the state steering is supplemented by comparative benchmarking and suggested that these systems would be highly accountable but prone to disintegration in the absence of contextual calibration. (Gray et al., 2022) have shown, in a PE-specific analysis, that PE providing discourses determine the prioritisation of PE-provisioning between health, performance, or citizenship-based, but these results are context-dependent. Taken together, these studies indicate that PE governance works based on multi-level processes between policy intent and institutional mediation.

The insights were built on comparative and regional scholarship which examined professional formation and institutional transformation. (Tang, 2024) also found diverse models of PE specialists training implemented in Chinese universities with a report of higher efficiency and scalability and limitations in digital-readiness and capacity of teachers. (Yerdanova et al., 2024) found a change towards governance in Kazakhstan that placed more emphasis on managerial and adaptive competencies, but stuck-in legacy norms remained. The studies of curriculum modelling by Kussainova et al. have shown that the flexibility of the modular governance is beneficial but fails to align the assessment whereas the works by (Ryskaliyev et al., 2024) indicate the effects of the visual technologies on the professional identity which are positive, despite the technological addiction. Evaluations at the system level by (Azhibayeva et al., 2024) found that quality assurance reforms increased responsiveness but needed stronger governance incorporations. (Jalilov et al., 2025) ethically and normatively predetermined, and (D'Agostino, 2024) argued that the effectiveness of governance is determined by the ability to reconcile the institutional diversity with policy coordination. Overall, the literature suggests that comparative PE management requires governance systems that align strategy, curriculum and professional development with being sensitive to national reform pathways.

National Implementation Models In University Pe Management: China And Kazakhstan

Preceding studies described national implementation models of PE management at the university level in China as being centrally controlled systems where the primary focus was on quality control and professionalism. According to (Aydin, 2024), the system of education in China was very centralised, and the state controlled it, whereby the curricula was standardised, and performance-based accountability influenced the governance of PE. In this design, Liang, developed a quality-management framework of PE bachelor training and proved that structured planning and constant assessment can increase programme coherence though at the cost of decreased pedagogical autonomy. In their applied level, (Chen and Chen, 2022) discovered that the large-scale implementation is enabled by state-coordinated systems of coaching and limited by regional differences. (Zhong et al., 2025) synthesised the technological dimensions and came to the conclusion that AI-based monitoring enhances the accuracy of assessment but presents ethical and capacity issues. Complementarily, (Mischenko et al. 2024) noted that when there is alignment between curriculum design, management oversight, as well as professional development, PE instructional outcomes are reinforced, depending on the institutional commitment.

However, the literature presented the PE management in Kazakhstan as a hybrid model that was influenced by the post-Soviet legacies and selective westernisation. (Barro and Cornell, 2022) claimed that incremental modernisation is linked to institutionalised centralised administration, thus affecting the sustenance of PE government. The leadership-centred reform with minimal decentralisation was emphasized by (Zhadira, 2019). At the tertiary level, (Bayanbayeva, 2025) demonstrated that the global ranking of universities selectively reinvents the priorities of PE programmes. (Niyazgulova et al. 2023) found Bologna-oriented modular designs, which are not evenly implemented in institutions. (Mukhpu-

lova et al., 2025) studies on professional formation showed that intercultural competence became a primary goal of PE teachers, but there are still gaps in its implementation. Evidence of digital-transformation suggested by (Abdigapbarova et al., 2025) showed that teacher engagement in hybrid models was improved, but this depends on the infrastructure, and (Zhamiyeva et al., 2022) described coordination issues in the international framework adaptation. (Tjia, 2022) placed PE governance in Kazakhstan in the context of overall geopolitical counterbalancing between Chinese connectivity and internal diversification.

Internationalization And Policy Convergence In The Belt And Road Context

The existing literature perceived the Belt and Road Initiative (BRI) as a major source of increased internationalisation of higher education and progressive convergence of policies in the Eurasian area. It was demonstrated that BRI-related exchange in vocational and higher education focuses on mobility schemes, joint programmes, and institutional partnerships (Shikhuhn, 2023), but their result varies according to national administrative capacity. Through a foreign-policy perspective, (Longhurst et al., 2022) argued that China is strategically using higher education as a soft-power tool in Central Asia, as compared to the EU regulatory diffusion and Russian historical power. Scholarship-based China-centric research by (Ge and Ho, 2022) and (Yue et al., 2022) indicated that the BRI is increasing scholarships, transnational campuses, and coordinated policy narratives and making China more attractive and revealing the issues of reciprocity and quality assurance. On the institutional level, Qiaomei and (Tonwimonrat, 2023) discovered that effective management of international students according to the BRI presupposes the localized administrative adaptation and cultural support mechanisms. BRI internationalisation is in interaction with the continuing reform processes in post-Soviet environments. According to (Anafinova, 2024), Kazakhstan selectively localises the norms of the Bologna Process, which forms the consumption of BRI-related cooperation. (Xu, 2022) presented that the BRI rearranges regional higher education by providing other internationalisation options, in addition to Western models. According to the student-mobility studies conducted by (Gao et al., 2024), there was the development of multipolar higher-education decisions with China as a regional centre of preference. The systematic synthesis of (Panibratov et al., 2022) has concluded that education cooperation according to the BRI supports gradual policy convergence but is not based on strong empirical assessment. (Woo, 2022) found that critical discourse analysis would disclose accounts of win-win situations that obscure imbalances, and (Li and Xue, 2024) found that Chinese higher education of graduate level internationalisation will continue towards BRI goals in an organized mobility and shared oversight. In general, the literature implies the partial convergence, but not the homogenized integration, with variousiated national implementation logics remaining within different sectors, including physical education management.Table 1 describe the keypoints of previous studies.

Table 1. Comparative Summary of Previous Studies on Physical Education Management and Governance

Study	Context / Country	Focus & Technique	Key Findings	Limitations	Relevance to Present Study
(Tang, 2024)	China	Comparative curricular analysis of PE specialist training models	Identified six dominant PE training models; highlighted efficiency and scalability of centralized, technology-enhanced systems	Lacked cross-national comparison; limited attention to implementation diversity	Informs analysis of China's centralized–digital PE management model
(Liang n.d.)	China	Quality management system modeling for PE bachelor programs	Demonstrated improved coherence and monitoring through structured planning and feedback loops	Reduced pedagogical autonomy; institution-level focus	Supports examination of quality assurance and governance mechanisms in China
(Barro & Cornell, 2022)	Kazakhstan	Policy and institutional reform analysis	Showed gradual modernization constrained by centralized administrative traditions	Not PE-specific; macro-level focus	Provides governance context for Kazakhstan's hybrid PE management model
(Bayanbayeva, 2025)	Kazakhstan	Policy analysis of global university rankings	Found selective adoption of Western governance indicators shaping institutional priorities	Focused on rankings rather than discipline-specific outcomes	Explains internationalization pressures affecting PE program positioning
(Ge & Ho, 2022)	China / BRI	Policy analysis of BRI-driven higher education internationalization	Reported expansion of scholarships and cross-border cooperation under BRI	Limited evaluation of disciplinary-level implementation	Frames BRI context for comparative PE management and policy convergence

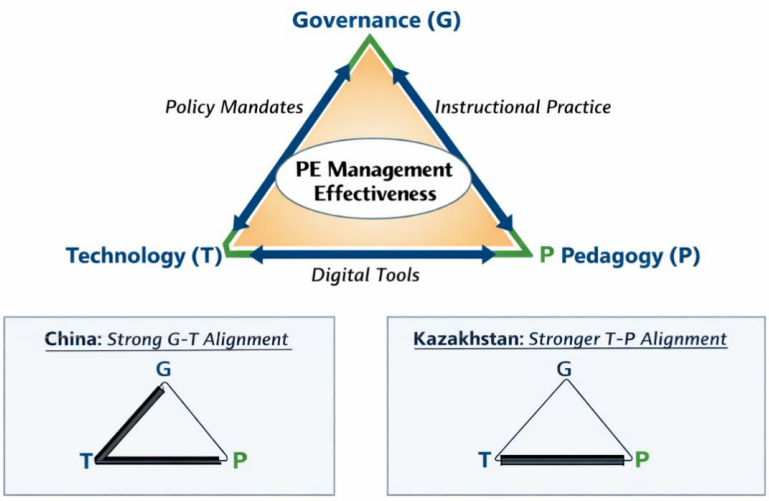
Method

Research Design and Comparative Framework

This paper was based on a qualitative, exploratory, and comparative multiple case study research design to investigate the physical education management systems in Chinese and Kazakhstani universities. Such design has made possible a detailed investigation of context-specific and complex phenomena and has made possible the comparison of implementation processes in different types of governance logics, as opposed to merely finding superficial differences.

The analysis was designed based on the Governance–Technology–Pedagogy (GTP) conceptualization that physical education management is a dynamic relationship between governance structures, technological infrastructures, and pedagogical practices.

Figure 1. Governance–Technology–Pedagogy (GTP) Triadic Framework for Physical Education Management Effectiveness



The GTP framework conceptualizes the effectiveness of physical education management as seen in Figure 1, as a factor of the alignment between the governance structures, technological infrastructures and pedagogical practices.

The triangular structure is symbolic of the interdependence of the three dimensions and the directional arrows depict dynamic interaction that affects the management effectiveness.

Data Collection Techniques

The research used qualitative document analysis as the fundamental method of data collection with a multi-source triangulation approach to provide better depth and validity in the analysis.

- National policy documents: The national policy documents include: Healthy China 2030, the Physical Education Guidelines of the Ministry of Education, the National Student Physical Fitness Standard, and the State Program of Education and science development (2023-2029) of Kazakhstan and legal provisions on physical culture and sport.
- Institutional documents: including publicly available curricula, program specifications, and strategic plans of the selected universities.
- Bilateral agreements: memoranda of understanding, cooperation agreements between Chinese and Kazakhstani universities (2023-2025).
- Secondary sources: Peer-reviewed journal articles, book chapters, and conference proceedings in English, Russian, and Chinese published in (2020-25).

- The chosen period (2020-2025) was explained by the fact that it reflects the recent changes in education, post-pandemic changes, and the dynamics of the Belt and Road Initiative.

Analytical Procedure

Thematic analysis and cross-case comparative analysis were used to analyze data within the GTP framework. The analysis was carried out in three steps:

1. Within-case analysis: The systems of individual countries were analyzed separately, and the data was coded into four dimensions, namely, governance structures, integration of curriculum and technology, assessment systems, and internationalization strategies.
2. Cross-case comparison: Coded data were compared systematically to find out convergence and divergence patterns, especially between the centralized-digital and hybrid-adaptive governance models.
3. Theoretical interpretation: The results were explained through the prism of the norm localization theory and multi-level governance views, which allowed achieving an explanatory interpretation of the process of global trends adaptation in national contexts.

Methodological Justification

The qualitative comparative method was chosen because it is appropriate to examine complex institutional structures, and settings of governance that are context-specific. In contrast to quantitative approach, this one provides an opportunity to gain a more in-depth insight into the interplay between the concept of governance, technology and pedagogy and determine the structural differences present in the context of various nations.

Validity and Reliability

Data triangulation across various sources, such as policy documents, institutional records, and scholarly literature, was used to validate the data. The reliability was improved by systematic coding and use of GTP analytical framework across the study.

Ethical Considerations and Limitations

The research was based solely on the publicly accessible documents and did not employ any human subjects; thus, there was no need to obtain ethical approval. A major drawback, though, is that the documentary sources will mostly represent official policies and might not be a complete reflection of the real practices of implementation. Also, the fast changing character of the educational reforms, especially those related to digitalization and government, implies that the findings are the snapshot of a dynamic situation in time.

Results

The findings of the comparative analysis show that there is a great variance between the governance structures that inform physical education (PE) management in Chinese and Kazakhstani higher institutions of learning. Such variations indicate the individual institutional formations, political-administrative cultures, and context-based alterations to the global educational governance patterns.

China: Centralized-Digital Governance Model

The results show that the Chinese system of higher education is highly centralized in its governance model with vertical policy flow, uniformity in regulations and a high level of integration of digital monitoring systems. The institutional analysis of the main national policy frameworks, such as the Healthy China 2030 Plan and the guidelines set by the Ministry of Education, shows that PE management is institutionally embedded in a more comprehensive health governance system, in which universities will be the main implementation units in a top-down administrative system.

The findings also indicate that this form of governance is designed to have three main mechanisms, which include centralized policy making, compliance monitoring enabled by technology and perfor-

mance based accountability mechanisms. National-level guidelines set mandatory physical fitness levels, curriculum models and testing procedures which are relayed via provincial bodies and applied at the institutional level with minimal local adjustment.

The six Chinese case universities have provided empirical evidence that there is high level of institutional standardization. There was also consistency in the curriculum design, assessment instruments and reporting systems within institutions regardless of the type of institutions and their location. Particularly, the National Student Physical Fitness Standard was implemented in all institutions with the same measurement criteria, assessment schedules, and a centralized system of data reporting.

Another insight of the analysis is that there is a good Governance-Technology (G-T) fit in the Chinese model. According to institutional strategic reports, there is rampant usage of artificial intelligence-based surveillance systems to monitor student physical activity, attendance, fitness performance and biometric indicators using wearable devices and smart campus systems. These technologies provide the opportunity to track the PE 24/7, and the management of PE will cease to be a periodic administrative process, but a continuous, data-driven process of its governance.

An example to draw on is Beijing Sport University where institutional records indicate that an integrated Smart PE Management Platform has been put in place. This system will help to consolidate the data of fitness testing, course administration, facility usage, and student health data into a centralized dashboard that can be accessed by university administrators and higher-level authorities.

On balance, the findings prove that the Chinese system of governance is focused on efficiency, scalability, and standardization based on the incorporation of digital technologies and central control systems. But this great degree of system coherence at the same time limits institutional autonomy and restricts pedagogical innovation.

Kazakhstan: Hybrid-Adaptive Governance Model

Conversely, the results suggest that the university governance model of Kazakhstani universities is the hybrid-adaptive model that incorporates the post-Soviet administrative heritage with the current reforms in line with the Bologna Process and the new digitalization efforts. This model shows the transition of Kazakhstan between the traditional centralized governmental systems inherited and modernization towards internationalization.

The policy documents since 2022 have become more aligned with European Higher Education Area standards such as implementing ECTS-based curricula and competency-based frameworks. Nevertheless, the findings indicate institutional practices still embody aspects of the Soviet-style of governance, including centralized curriculum approval process, calculation of workloads in terms of academic hours, as well as hierarchical reporting structures.

The analysis also finds that there is a large difference in PE management implementation between institutions. There are greater rates of modular and competency-based programs adoption in flagship universities, and more conventional physical culture models and normative fitness testing methods in regional institutions. This difference demonstrates that the application of governance is localized adaptation and not uniformity in the implementation of policies.

Weak Governance Technologies (G T) alignment is also revealed in the results as opposed to the Chinese system. Despite the focus of the discourse of national policy on digital transformation and the creation of a smart university, there is institutional evidence that technological integration is still skewed. The majority of institutions have simple learning management systems and do not have specialized PE analytics and performance monitoring digital infrastructures.

In general, Kazakhstani model of governance is more flexible, culturally responsive, and institutionally autonomous. Nevertheless, this flexibility comes with coordination issues, inconsistencies in application, and constraints to the realization of standardized quality assurance between institutions.

Comparative Analysis of Governance Structures

Table 2 summarizes the key governance differences identified through the comparative analysis.

Table 2. Comparative Governance Architectures in PE Management

Governance Dimension	China (Centralized-Digital)	Kazakhstan (Hybrid-Adaptive)
Policy Formation	Centralized formulation with vertical transmission	Hybrid formulation combining national frameworks with Bologna Process adaptation
Institutional Autonomy	Limited; standardized implementation required	Moderate; variation across institutional tiers
Regulatory Mechanisms	Mandatory national standards with digital compliance monitoring	Modular frameworks with uneven enforcement
Administrative Logic	Hierarchical, performance-based accountability	Dual-track combining Soviet legacies with Western reforms
Digital Infrastructure	Comprehensive AI-driven monitoring platforms	Emergent, institution-specific systems
Quality Assurance	Centralized testing and data aggregation	Mixed approaches; ECTS-compatible frameworks with implementation gaps
Reform Trajectory	Deepening digitalization and algorithmic governance	Ongoing localization of Bologna Process with persistent hybridity

The comparative findings show that China shows a highly integrated system of governance with high central coordination and high-level technological infrastructure, as opposed to Kazakhstan which has a pluralistic and changing system of governance with institutional diversity and responsive implementation of policy.

The identified difference in the political systems may be explained under the prism of the norm localization theory. The results indicate that China is an example of the congruence building, in which international standards of digital governance and evidence-based management are mechanized into the already established centralized political systems. By contrast, Kazakhstan is indicative of a grafting process, whereby aspects of extrinsic governance models, including the Bologna Process and digitalization plans, are selectively integrated into existing institutional models, leading to a hybrid and stratified system of governance.

Curriculum Models and Pedagogical Technology Integration

This part summarizes the findings on curriculum structures and technological integration, in line with the research aim of exploring the role of governance architectures in pedagogical practices in the Governance-Technology-Pedagogy (GTP) framework.

China: AI-Integrated Physical Literacy Curriculum

The review showed that Chinese universities adopt a standard curriculum model that is geared towards the enhancement of physical literacy by use of technology-based pedagogical strategies. There are documentary signs that this change is being motivated by national policy requirements that rebrand physical education (PE) as an element of the overall student development and not just training in skills.

The common 2+X curriculum was observed in all six institutions of the case, and it comprised of two mandatory semesters of general PE and then optional specialization courses. The movement competency, physical fitness, and lifelong physical activity are the main focus of core curriculum. There was standardization in the contents of the curriculum which comprised of basic movement patterns, traditional Chinese exercises like Tai Chi and Wushu, modern fitness programs and foundations of competitive sports.

One of the notable discoveries is that there is a high degree of technological integration which means that there is a high Technology-Pedagogy (T-P) interaction occurring within a centrally coordinated system. The teaching and assessment systems based on AI enhancement are proven to be implemented widely in three main areas by institutional documents.

To begin with, smart assessment systems are based on computer vision and motion-capture technologies that are used to analyze student movement patterns. According to the evidence compiled by Beijing Sport University, these systems have been shown to be between 97.5% accurate when measuring posture, technique and exercise performance, and they offer real-time automated feedback.

Second, adaptive exercise programs are created on personalized learning platforms using the data on student fitness, health profiles, and performance trends. These systems are based on machine learning algorithms that optimize training processes, and the wider implementation of precision education principles.

Third, the application of virtual and augmented reality technology was observed in the chosen institutes, especially to the activities that needed special infrastructure or increased safety. As an example, Tsinghua University has documented the use of VR simulations in the training of skiing, rock climbing, and martial arts.

Such results are aligned with the experiential learning model that focuses on personalization, agency of students, and feedback loops (Tang, 2024). Nevertheless, the findings also reveal the presence of differences in the amount of technological adoption between the institutional levels with elite universities having more developed systems.

All in all, the findings indicate that Chinese curriculum model is highly standardized, data-driven optimization and that there is a high degree of consistency between governance and technology (G-T), but this restricts the flexibility in pedagogy of the system.

Kazakhstan: Trilingual, Modular, and Adaptive Curriculum Model

Conversely, the findings show that Kazakhstani universities have a modular, flexible, and adaptive model of curriculum influenced by the national language policies, alignment to the Bologna Process, and the priorities of inclusive education.

It was found that PE programs are organized in the credit-based system, which is most commonly between 8 and 10 ECTS credits, but there is a large variation among the institutions. In contrast, to the standardized Chinese model, the curriculum design in Kazakhstan shows the institutional autonomy and adaptation to the local context.

One of the main results is the inclusion of trilingual education (Kazakh, Russian, and English) into PE programs. The content of the curriculum is a blend of culturally oriented movement practices with international fitness strategies which represent a hybrid pedagogical orientation.

The findings also suggest that adaptive PE models are adopted to meet the needs of a wide range of students, such as those with physical impairments or physical inabilities. These models utilize customizable learning routes and variousiated assessment standards.

Regarding the technological integration, the results show relatively low and pedagogically based usage of digital tools. The majority of institutions also do not use advanced AI-based monitoring and analytics but instead learning management systems and simple digital tools to facilitate teaching.

These findings suggest that there is a better Pedagogy-Technology (P-T) fit than in China where technology is applied to facilitate the learning activities as opposed to establishing governance control.

In general, the model of the Kazakhstani curriculum is more focused on inclusivity, cultural responsiveness, and pedagogical flexibility, but it does not have the technological systemic nature that is present in the Chinese model.

Comparative Analysis of Curriculum and Technology Integration

Table 3 summarizes the key differences identified between the two systems.

Table 3. Comparative Curriculum Models and Technology Integration

Curriculum Dimension	China (AI-Integrated)	Kazakhstan (Trilingual-Modular)
Structural Model	Standardized "2+X" model with mandatory core and elective specialization	Modular credit-based system with institutional variation
Content Focus	Physical literacy, fitness standards, scientific training	Trilingual instruction, cultural movement traditions, adaptive PE
Learning Philosophy	Data-driven personalization and algorithmic optimization	Student-centered, culturally responsive, inclusive education
Technology Integration Level	High: AI assessment (>97.5% accuracy), VR/AR, personalized systems	Limited: LMS-based support, basic digital tools
Technology Function	Performance optimization, automated assessment, precision education	Instructional support, communication, content delivery
Assessment Approach	Algorithmic evaluation and real-time feedback	Competency-based and differentiated assessment
Pedagogical Flexibility	Limited within standardized national framework	High variation across institutions
Instructor Role	Data analyst and system facilitator	Adaptive educator and cultural mediator

Comparative findings suggest a direct influence of governance structures in Section 4.1 on curriculum structures. In particular, the centralized-digital model of governance in China allows the systematic incorporation of technology and the standardization of curriculum practice, which is highly Governance-Technology (G–T) fit in the GTP model. But this alignment limits pedagogical flexibility (P).

By contrast, the hybrid-adaptive governance model in Kazakhstan enables more pedagogical variability and cultural responsiveness leading to better Pedagogy Technology (P-T) alignment but worse systemic integration of governance and technology (G-T).

Assessment and Quality Assurance Systems

The findings suggest that there is evident dissimilarity in evaluation and quality assurance systems between the Chinese and Kazakhstani universities which is indicative of the differences in governance systems, and technological integration.

China: Technologically-driven and Standardized Assessment System.

The results indicate that China has a very standardized national assessment system in the form of the National Student Physical Fitness Standard that serves as a student assessment system, an institutional performance system, as well as a system of monitoring the health of the population.

Every university analyzed uses the same testing standards that are used to test the major fitness indicators (endurance, strength, flexibility, and body composition). The findings indicate good Governance-Technology (G-T) fit with assessment data being collected digitally, centrally stored and constantly monitored.

Other institutional data also shows the incorporation of AI-assisted evaluation systems that automate performance analysis and give real-time feedback, improving accuracy and consistency. This system provides comparability among institutions and assists in making decisions at the policy level.

The results however indicate that such a centralized method restricts the contextual flexibility and limits the range of alternative or formative assessment strategies.

Kazakhstan: Flexible and Competency-Based Assessment Model

Conversely, the findings indicate that the assessment method used by Kazakhstani universities is more flexible and institutionally diverse and in accordance with the principles of the Bologna Process. Assessment systems are generally competency based, which involves continuous evaluation techniques like coursework, practical performance and portfolio assessment. Analysis shows that there is a difference in the institutional implementation in different institutions, which is based on the institutional capabilities and priorities.

There is still a lack of technological integration, with majority of universities using a simple digital platform as opposed to sophisticated analytics or automated systems. It means that there is a lower level of GovernanceTechnology (G-T) alignment and higher PedagogyAssessment flexibility.

The results also emphasize the adaptive assessment practice that is applied to accommodate various student needs, especially when it comes to inclusive education.

Table 4 shows the comparative assessment and quality assurance systems:

Table 4. Comparative Assessment and Quality Assurance Systems

Dimension	China (Standardized-Digital)	Kazakhstan (Flexible-Competency)
Assessment Model	National standardized testing system	Competency-based continuous assessment
Evaluation Scope	Fitness, performance, biometric data	Skills, participation, learning outcomes
Technology Use	High: AI systems, centralized databases	Low: LMS-based and manual systems
Data Function	Monitoring, governance, policy evaluation	Instructional support and grading
Flexibility	Low	High
Quality Assurance	Centralized and uniform	Decentralized and variable

The findings substantiate the fact that governance architectures directly influence assessment systems. The centralized model of China provides consistency, scalability, and data-driven control, but the hybrid model of Kazakhstan allows flexibility and inclusiveness but adds variability to quality assurance.

China and Kazakhstan have a high G1-T fit within GTP, and a better Pedagogy-Assessment flexibility with a lower technological integration, respectively.

Internationalization Strategies and BRI-Era Cooperation

This part shows the findings on globalization policies in PE management systems, policy dynamics in the context of Belt and Road Initiative (BRI) and the wider geopolitical context.

China: BRI-Driven Educational Attraction Model

The findings point to the fact that China pursues an inbound-based approach to internationalization that revolves around attracting students, institutional collaboration, and technology transfer within the framework of the BRI.

Empirical data indicates that there are over 18,000 Central Asian students studying in Chinese universities and they are mostly enrolled via scholarship programs of BRI by China Scholarship Council and provincial governments. These students are a large percentage of those enrolling in PE and sports science programs especially in universities like Beijing Sport University.

The results also show that internationalization is realized in the form of organized bilateral cooperation (2023-2025), such as joint research in the field of sports science, faculty exchange programs, training of PE professionals, and technical assistance of sports infrastructure and digital PE management systems. Interestingly, cooperative applications like the Kazakh-Chinese Scientific and Technological Alliance are extended to sports analytics and monitoring of physical activity.

The major outcome is the introduction of China as a source of technology, exporting digital PE management systems, fitness assessment tools and instructional technologies to other countries. This is an extension of a wider soft power approach that involves technological leadership.

The asymmetric mobility pattern is also revealed in the analysis as the movements of students are more towards China with low mutual mobility. This supports the fact that China is an educational hub in the region.

On the whole, the internationalization policy of China focuses on connectivity, capacity building, and incremental policy influence, but the critical views note that there may be an asymmetry in agenda-setting (Woo, 2022).

Kazakhstan: Outbound and Diversified Internationalization Strategy

Conversely, the findings indicate that Kazakhstan uses outbound-oriented and diversification-based approach that tries to balance geopolitics and policy independence.

The results show that there is a great focus on outbound student and faculty mobility which is mainly in form of programs like the Bolashak scholarship which assists in advanced studies in Europe, Russia and North America. PE and sports science students are also actively involved in such mobility schemes.

The internationalization strategy adopted by Kazakhstan is also typified by the interaction with various reference systems. It has been demonstrated that it works in parallel with European institutions (Bologna Process), Russian academic networks, and Chinese partners, which can be seen as a multi-vector approach instead of the one based on a single model.

Selective adoption of technology is also evidenced by the results where institutions are involved in knowledge sharing and learning with each other, but decisions on implementation remain under their control. Kazakhstan is not dependent on technology to an extent as China is.

Also, the results reveal the desire of Kazakhstan to be a regional educational center, to attract students of the neighboring Central Asian states with the help of flagship universities.

On the whole, the aims of the strategy of Kazakhstan are oriented to sovereignty, strategic independence, and adaptation to the context in the global educational interaction.

Table 5 shows the Comparative Internationalization Analysis:

Table 5. Comparative Internationalization Strategies in PE Management

Dimension	China (BRI-Driven Attraction)	Kazakhstan (Diversified Outbound)
Orientation	Inbound student attraction	Outbound mobility and diversification
Student Mobility	18,000+ Central Asian students; limited reciprocity	Bolashak and institutional outbound programs
Partnerships	Technology transfer and capacity building	Knowledge exchange and balanced cooperation
Technology Role	Provider of digital systems and innovations	Selective adopter of external technologies
Policy Approach	Gradual influence through institutional integration	Maintenance of autonomy and strategic balance
Geopolitical Logic	Regional leadership and soft power expansion	Multi-vector engagement and diversification
PE Cooperation	Joint programs, training, and sports science research	Selective participation across multiple systems

The findings reveal that the internationalization strategies are informed by different governance logics. China exemplifies a norm entrepreneurship strategy, which actively propagates its governance and technological paradigms in the BRI framework, and Kazakhstan a norm buffering strategy, which is selectively involved in various systems to prevent dependency.

In the GTP framework, China has a high GovernanceTechnology (G-T) alignment that spills into internationalization whereas Kazakhstan has policy flexibility and autonomy which is based on diversified engagement.

Synthesis: The Governance-Technology-Pedagogy (GTP) Framework Application

The comparative findings prove that the effective management of physical education (PE) is based on the consistent integration of the governance (G), technology (T), and pedagogy (P). The differences in the strength of these relationships account for structural differences between the Chinese and Kazakhstani systems.

Chinese system has good Governance-Technology (G-T) fit, whereby the centralized governance facilitates large scale use of digital systems to standardize and monitor and hold accountable. Nevertheless, there is still a lack of GovernancePedagogy (G-P) fit, with standardized policies and algorithmic evaluations diminishing the pedagogical flexibility. The Technology Pedagogy (T-P) is a dual relationship, on the one hand, technology enhances personalization and real time feedbacks; on the other hand, technology strengthens standardization, limiting the flexibility of instruction.

Conversely, the Kazakhstani system is less G-T aligned because there is a lack of coordinated technological implementation due to the structures of hybrid governance, which leads to asymmetrical digital integration. Nevertheless, T-P alignment is relatively high and technology is mostly in favour of pedagogical requirements like access, communication and cultural adaptation and not governance control. The G-P relationship is flexible and permits institutional variation and responsiveness to the situation, but this decreases standardization and uniformity in quality assurance.

In general, the results show that both systems are not completely coherent in all three dimensions. The efficiency of China, with its G-T alignment, and the lack of flexibility of Chinese pedagogies, and the flexibility of Kazakh pedagogies and the lack of systemic alignment of governance and technology.

The GTP framework also implies that reform needs to be balanced in terms of alignment mechanisms. Institutional flexibility in China to enhance G–P and T–P alignment may enhance responsiveness in pedagogy without compromising centralized coordination. In Kazakhstan, efficiency and pedagogical autonomy can be achieved by improving the G-T fit with a coordinated technological infrastructure.

This framework helps to add to the educational management theory because it shows that the system of governance, technology, and pedagogy is interdependent. It questions the linear assumptions of technological or governance determinism and offers a dynamic model not just to PE management but to other educational settings that are in the process of digital transformation and internationalization.

Discussion

Interpretation of Key Findings

The findings have shown that the variations of PE management in China and Kazakhstan are based on different principles of governance and not just a structural difference. Although both systems react to

the pressures of globalization (digitalization) and internationalization, their institutional responses are quite different because of the difference in the capacity of governance and the policy focus.

The centralized-digital model of China explains the high degree of standardization, technological integration and efficiency of monitoring that was witnessed in the results. Conversely, the hybrid-adaptive system of Kazakhstan is an indication of a balance between the established institutional frameworks and the continuous reforms which are in line with the international standards.

Comparison with Existing Literature

The results are consistent with the existing literature that emphasizes the increasing use of digital technologies in physical education, especially in East Asia, where AI-based systems have a beneficial impact on performance monitoring and movement analysis (Zhong et al., 2025). Nonetheless, this research adds to the literature by proving that the effectiveness of this type of technology is highly reliant on centralized governance models that provide coordination and adherence.

Likewise, the findings are consistent with the findings of studies on post-Soviet higher education reforms, where the system in Kazakhstan is characterized as a hybrid system that incorporates Bologna Process principles with the local customs (Anafinova, 2024; Niyazgulova et al., 2023). This paper builds upon this by demonstrating the ways in which this hybridity is applied in PE management in the form of modular curricula, instruction in three languages and flexible assessment systems.

In addition, unlike in the past research on sports education, which has mostly been based on pedagogical or national background (Chen & Chen, 2022; Mukhpulova et al., 2025), this study presents a comparative governance approach, which shows how institutional structures influence the results of implementation.

Critical Analysis of Governance–Technology–Pedagogy Interaction

An important lesson learnt during the study is that effective PE management is not guaranteed by technological advancement. Rather, the results are based on the compatibility of governance systems, technological systems, and pedagogical practices.

A high GovernanceTechnology (G-T) alignment in China facilitates efficiency, scalability and standardization of implementation. Nonetheless, this congruence diminishes Governance–Pedagogy (G–P) flexibility, which restricts responsiveness to varying needs of the students. On the other hand, Kazakhstan has a higher level of pedagogical flexibility but lower level of G -T alignment resulting in the disproportionate integration of technology and inconsistency in its implementation.

This supports the fact that education systems are interdependent systems, where the lack of balance between governance, technology and pedagogy results in trade-offs between efficiency and adaptability.

Internationalization and Policy Implications

The results offer fresh information on the internationalization strategies, especially in the Belt and Road Initiative (BRI). Although the current literature is mostly concerned with student mobility and institutional collaboration (Ge and Ho, 2022; Yue et al., 2022; Panibratov et al., 2022), this paper demonstrates that the concept of internationalization also influences such discipline-specific areas as PE.

The inbound-oriented strategy adopted by China with the help of mass scholarship and technological transfer is opposed to the outbound and diversified strategy of Kazakhstan. The noted unequal mobility and influence can justify claims that BRI collaboration can be characterized by uneven power relations even with the discourse of mutual gain (Woo, 2022).

These results emphasize the idea that geopolitical location and governance capabilities mold internationalization strategies as opposed to homogenous trends across the globe.

Theoretical Contribution: Advancing the GTP Framework

This research adds to theory through an empirical validation of the Governance Teaching Technology Pedagogy (GTP) model. This study indicates that governance, technology, or pedagogy are interdependent unlike the previous research that analyzes them separately (Chen and Chen, 2022; Mukhpulova et al., 2025).

The Chinese case demonstrates that a high G–T alignment can facilitate the coordinated implementation, whereas the Kazakhstani case shows that a weaker alignment can lead to a variety of institutional outcomes. This ascertains that reform success lies in systemic coherence as opposed to interventions in isolation.

Significance of the Study

The study has important implications for policy and practice. It implies that centralized systems ought to be more flexible in pedagogy to prevent rigidity, whereas decentralized systems ought to be more effective in technological coordination to enhance efficiency. This is in line with the wider governance theories that focus on the issue of control and autonomy in higher education (Madsen, 2022).

On an international scale, the results show that the global reform agendas are localized in various ways in national settings. In line with the norm localization theory, China is an embodiment of coordinated technological growth, and Kazakhstan is an embodiment of selective adaptation and diversification.

Conclusions

This paper has shown that the variation in the management of physical education (PE) in China and Kazakhstan is essentially influenced by the alignment of governance-technology-pedagogy and not homogenous reactions to the international reform pressure. The results prove that the centralized-digital model in China allows achieving a high degree of standardization, technological integration, and coordination of the system, and the hybrid-adaptive model in Kazakhstan provides pedagogical flexibility, multilingual delivery, and diversified international interaction.

Notably, the findings indicate that none of the models is superior per se, but rather the effectiveness lies on the level of fit between the governance structures, technological infrastructure and pedagogical goals. This is empirically supported by the use of the GovernanceTechnologyPedagogy (GTP) framework which shows that the difference in the implementation efficiency, adaptability and consistency across institutions can be explained by the difference in this alignment.

The research adds to the comparative education research by taking the analysis beyond Western-centric models and showing that the drivers of global reform, digitalization, health policy integration, and internationalization, have context-specific effects. It also points out that both centralized and decentralized systems can pose the risk of lower pedagogical responsiveness, and technological coordination and quality assurance can be problematic in both systems.

In practical terms, the results indicate that China needs to increase pedagogical flexibility in its digital governance frameworks and Kazakhstan needs to increase coordinated digital infrastructure and quality assurance systems without jeopardizing the independence of institutions. On the bilateral level, the China–Kazakhstan collaboration as a part of the Belt and Road Initiative can be enhanced with the balanced knowledge exchange that incorporates the technological potential of China with the knowledge of flexible and inclusive education models in Kazakhstan.

Future studies must be longitudinal and mixed-method to assess the effects of such management models on the outcomes of students, especially physical literacy, engagement, and equity. Moreover, more comparative studies in other areas should also be conducted to verify the external validity of the GTP framework in other educational settings.

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Authors and translators' details:

Jiuyang Wang	18540348587@163.com	Author
Tolegenuly Nurzhan	nurzhan_tolegenu@mail.ru	Author