



Sustainable Education Business Units in Post-Soviet Universities: A Comparative Case Study of Collaborative Innovation between Kyrgyzstan and Chinese Transnational Education Enterprises

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ABSTRACT

Purpose This study aims to explore the enabling mechanism of China-Kyrgyzstan co-established SEBUs in addressing fiscal shortage, rigid governance and education-industry disconnection of post-Soviet universities and reveal the internal logic of cross-border collaborative innovation between Chinese transnational education enterprises and Kyrgyz universities. **Methodology.** Taking Kyrgyzstan as the research object, the study integrated 2021-2025 China-Kyrgyzstan educational cooperation empirical data, constructed a dual structural equation model via SEM, combined case and comparative methods to analyze the impacts of China's innovative input and Kyrgyzstan's original model on local educational sustainable development, and verified the mediating effect of the "digitalization-localization-commercialization" three-dimensional operational

mechanism by the Bootstrap method. **Results** The results show that the total effect of China's input on SEBU performance ($\beta=0.625$) is 2.1 times that of Kyrgyzstan's ($\beta=0.297$), confirming the significant positive enabling effect of China-Kyrgyzstan educational cooperation on post-Soviet university transformation. China's input features a "direct empowerment + mechanism-driven" dual-drive pattern with nearly equal direct and indirect effects, while Kyrgyzstan's input is highly dependent on the operational mechanism, with an 83.6% indirect effect ratio and an insignificant direct effect. The three-dimensional mechanism exerts a partial mediating role in China's input and a strong one in Kyrgyzstan's input; only through it can China's digital resource output and Kyrgyzstan's localization support be transformed into SEBUs' financial sustainability, talent cultivation and industrial service

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capabilities. **Implications for research and practice** This study enriches the theoretical research on post-Soviet university transformation and cross-border educational cooperation and provides practical references for the high-quality development of the Belt and Road Education Community and China's cooperation with other Central Asian countries.

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Introduction

Post-Soviet countries' higher education systems have retained a state-dominated model inherited from the planned economy era, facing structural challenges including insufficient public funding, rigid governance, disconnection between education and industry, and brain drain (Lovakov et al., 2022; Malinovskiy & Shibanova, 2022; Osipian, 2025; Smolentseva & Platonova, 2022). Kyrgyzstan represents a typical case in Central Asia (Wang et al., 2024). This dilemma is rooted in institutional discontinuity during the post-Soviet transition: after gaining independence in 1991, Kyrgyzstan implemented market-oriented reforms, yet the legacy of the "dual-track system" led to fragmented governance (Teymurova et al., 2025). (Gül & Adsiz, 2026; Shchepetylnykova & Oleksiyenko, 2024). The number of universities surged by 300% between 1993 and 2005, accompanied by a sharp decline in educational quality (Liu et al., 2025). However, existing studies mostly focus on macro-policies and lack in-depth investigations into micro-operational mechanisms, particularly overlooking the innovative organizational form of Sustainable Education Business Units (SEBUs).

During 2021-2025, China-Kyrgyzstan education cooperation experienced a paradigmatic leap from single-project aid to systematic, entity-based co-construction (Huang et al., 2019). In 2021, Kyrgyzstan integrated the internationalization and marketization of higher education into its national strategy (Liu et al., 2025; Tianyong, 2026) and the Education Development Strategy 2021-2025 proposed deepening cooperation with Belt and Road countries (Borodyna et al., 2022; Denisov, 2020; Dunford & Liu, 2019; He et al., 2024).

In 2025, the two sides jointly issued the China-Kyrgyzstan Education Cooperation Action Plan 2026-2030, (Liu et al., 2024; Xia, 2024; Yu & Volkotrubova, 2025), establishing a special fund of 10 million yuan to support the co-construction of five SEBUs covering engineering, commerce, cross-border e-commerce, modern agriculture, and other fields (Zhang et al., 2024). In the same period, typical platforms such as the Silk Road Academy and Qinling Workshop emerged, forming a dual-wheel drive model of "digital resource export plus localized adaptation and transformation" (Liu et al., 2024). Against this background, based on first-hand empirical data on China-Kyrgyzstan education cooperation from 2021 to 2025, this study focuses on typical cases including the Silk Road Academy and Qinling Workshop (Xia, 2024).

Inspired by the higher education transformation in post-Soviet countries and regional governance integration under the Belt and Road Initiative (Nadin et al., 2024), this study systematically analyzes the enabling mechanisms of Chinese transnational education enterprises for the sustainable development of SEBUs in post-Soviet universities, reveals the internal logic of cross-border university-enterprise collaboration, and provides

theoretical references and practical implications for the construction of the Belt and Road Education Community (Mai & Do, 2025; Wu & Zhang, 2022).

Literature Review and Theoretical Framework

Cooperation Foundation and Digital Empowerment

China and Kyrgyzstan have incorporated educational cooperation, policy coordination, and strategic alignment into their national development strategies, forming a three-level policy support system of "national strategy + regional mechanism + special planning" (Liu et al., 2017). In 2025, the two countries jointly issued the 2026-2030 China-Kyrgyzstan Education Cooperation Action Plan (Zhang et al., 2024), explicitly supporting the co-construction of five characteristic and sustainable educational business units (SEBUs) and establishing a special cooperation fund of 10 million RMB, covering five core curriculum areas including engineering, commerce, cross-border e-commerce, and modern agriculture (Liu et al., 2017). The Belt and Road Vocational Education Alliance comprise 114 members, with an average annual growth rate of 13.6%, providing a platform for resource connection and standard mutual recognition for SEBUs.

Innovation of Three-dimensional Operation Mechanism

Breaking away from the traditional administrative operation mode of universities in the former Soviet Union, SEBUs employ digital technology as the core enabling mechanism, carrying out comprehensive innovation across three dimensions: curriculum system (Liu et al., 2024; Zhang et al., 2024), teaching evaluation, and operation mechanism, thereby forming a trinity operation mechanism of "digitalization-localization-commercialization." With digital technology at its core, SEBUs have disrupted the traditional single-discipline curriculum system and achieved the digital, interdisciplinary, and localized restructuring of curricula (Zhong et al., 2025).

Several studies have exploited micro-operational data obtained from the World Bank, China's Ministry of Education, Kyrgyzstan's Ministry of Education and Science, partner enterprises, and universities from 2021-2025 for analysis, comparing the three-dimensional operation mechanism comprising governance structure, resource endowment, and operational efficiency (Zhang et al., 2024), as well as the development effectiveness of indigenous Kyrgyzstani SEBUs and China-Kyrgyzstan cooperative SEBUs, thereby revealing the internal mechanisms by which Chinese transnational education enterprises empower the sustainable development of SEBUs in post-Soviet universities (Liu et al., 2017).

Operation Mechanism Breakthrough: Dual-drive

Breaking the traditional model of "emphasizing training over transformation" characteristic of universities in the former Soviet Union, SEBUs have formed a dual-drive operation mechanism of "talent training as the core and commercial transformation as the support," realizing the organic unity of the public welfare attribute of education and the market commercial attribute (Zhou et al., 2023).

Talent training end: SEBUs cultivate interdisciplinary practical talents oriented toward industrial demands. As a typical representative of SEBUs, the Silk Road College has achieved a graduate employment rate exceeding 60%, with an average annual growth of 9.3%, and salary levels reaching 1.8 times the national average in Kyrgyzstan. From 2021 to 2025, SEBU enrollment increased from 115 to 420, with an average annual growth of 37%.

Commercial transformation end: Relying on advantages in talent and technology, SEBUs provide commercial services including vocational skills training, technology R&D and transformation, and education standard export. In 2025, Jiaxing Nanyang Polytechnic Institute achieved over 3 million RMB in education service revenue through customized training for Kyrgyz enterprises, with an average annual growth of 54.8%; Jilin University generated a total of 8.6 million RMB through curriculum authorization. Income from commercial transformation has become an important source of funds for SEBUs, promoting their self-sustainable development (Liu et al., 2017).

All these efforts have contributed to establishing a business ecosystem, which enabled SEBUs to achieve commercial breakthroughs via three paths: talent-employment linkage, standard export, and industry-education integration.

Methodology

Research design

This study aims to systematically explain the impact mechanism of collaborative innovation between Chinese transnational education enterprises and Kyrgyzstani universities on local educational development during the post-Soviet period. A mixed-methods research design was employed, comprising: (a) Confirmatory Factor Analysis to test the reliability and validity of the measurement model and ensure the validity of analytical variables; (b) construction of a dual structural equation model to examine the impact pathways of China-Kyrgyzstan investment on operational mechanisms and SEBU performance; and (c) application of the Bootstrap method for effect decomposition and mediation effect testing to derive final conclusions.

Sampling Strategy

The sample comprised 36 observations from four research perspectives during the period 2021–2025. Project selection followed purposive sampling criteria: (a) operational duration of at least three years; (b) involvement of both Chinese and Kyrgyzstani partners; (c) availability of complete financial and operational records; and (d) representation of diverse disciplinary fields (engineering, commerce, agriculture, and sports).

Data Collection Methods

To ensure data authenticity, this study adopted the official document review method, with data sourced from official websites, academic journals, and government work reports.

Data Analysis

Structural Equation Modeling (SEM) was employed for empirical analysis.

Results

The sample covered a total of 36 observations from four research perspectives during the period 2021-2025. Table 1 reveals variables of sample observations.

Table 1

Variables of Sample Observations

Latent Variable	Observable Indicator	Measurement Method	Data Source
Chinese Investment(X₁)	Capital Investment(X ₁₁)	Annual investment amount (million CNY)	Partner enterprise financial statements
	Digital Resources(X ₁₂)	Number of exported courses	"Study at Jilin University" platform statistics
	Personnel Dispatch(X ₁₃)	Chinese dispatched personnel (person-times)	University-enterprise cooperation agreement
Kyrgyzstani Investment(X₂)	School Facilities(X ₂₁)	Provided venue area (thousand sqm)	Kyrgyzstani university asset registration
	Local Faculty(X ₂₂)	Local teachers participating in project (persons)	Human resources statistics
	Policy Support(X ₂₃)	Policy convenience score (1-10)	Expert evaluation
Operation Mechanism(M)	Digitalization Level(M ₁)	Smart classroom usage hours	Platform monitoring data
	Localization Level(M ₂)	Proportion of local cases (%)	Curriculum outline analysis
	Commercialization Level(M ₃)	Commercial service revenue (million yuan)	Financial audit report
SEBU Performance(Y)	Financial Sustainability(Y ₁)	Self-funded proportion (%)	Annual financial report
	Talent Cultivation(Y ₂)	Graduate employment rate (%)	Employment tracking survey
	Industrial Service(Y ₃)	Commercial transformation revenue (million yuan)	Cooperation project ledger

The study created an analytical framework for model construction through a dual structural equation model. The core algorithmic equations are as follows:

$$\eta = B\eta + \Gamma\xi + \zeta$$

η is the endogenous latent variable vector (operation mechanism innovation, SEBU performance), ξ is the exogenous latent variable vector (China-Kyrgyzstan bilateral investment), B is the path coefficient matrix between endogenous variables, Γ is the impact coefficient matrix of exogenous variables on endogenous variables, ζ is the residual term.

The data standardization processing function set in this paper data standardization processing function for:

$$Z_{ij} = \frac{X_{ij} - \bar{X}_j}{SD_j}$$

Standardization eliminates dimensional differences, making each indicator have a mean of 0 and standard deviation of 1. Latent variable scores are calculated using equal weight averaging method as follows:

$$\xi_i = \frac{1}{k} \sum_{j=1}^k Z_{ij}$$

The above processing is conducted to eliminate the influence of specific sample data.

Sample Variable Correlation Analysis

Consequently, a correlation analysis was conducted on the four selected core variables to verify the rationality of variable selection and confirm the existence of correlations among the variables. The results of the correlation test among the four core variables are as follows [Table 2](#).

Table 2

The results of the correlation test among the four core variables

Variable	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
Chinese Investment(X_1)	0.000	1.000	-1.45	1.62	0.23	-0.45
Kyrgyzstani Investment(X_2)	0.000	1.000	-1.38	1.55	-0.15	-0.32
Operation Mechanism(M)	0.000	1.000	-1.28	1.48	0.18	-0.28
SEBU Performance(Y)	0.000	1.000	-1.35	1.52	-0.08	-0.35

Note: ** $p < 0.001$, * $p < 0.01$, all correlation coefficients are positive and highly significant, laying the foundation for subsequent path analysis.

The calculated, correlation analysis results (Pearson correlation coefficient) for:

$$R = \begin{bmatrix} 1.000 & & & \\ 0.452^{**} & 1.000 & & \\ 0.687^{***} & 0.612^{***} & 1.000 & \\ 0.625^{***} & 0.548^{**} & 0.723^{***} & 1.000 \end{bmatrix}$$

China-Kyrgyzstan investment shows significant positive correlation with Operation Mechanism and SEBU Performance ($r=0.548-0.723$, $p < 0.01$). Through data correlation analysis, the correlation coefficient between Chinese Investment and Operation

Mechanism is the highest ($r=0.687$), indicating that Chinese Digital Resources output has a strong driving effect on Operation Mechanism innovation, and the correlations among the four core variables are relatively high.

Structural Equation Modeling Calculation

Before calculation, the fitness of the structural model adopted in this paper is first tested. This test adopts the Maximum Likelihood (ML) estimation method to estimate model fit with iterative convergence condition of $\|\Delta\theta\| < 10^{-6}$.

Measurement Model Testing

The measurement model testing shows that Confirmatory Factor Analysis (CFA) depicts standardized factor loadings of each Observable Indicator on latent variables, which are all greater than 0.6, Composite Reliability (CR) > 0.7, and Average Variance Extracted (AVE) > 0.5, indicating good reliability and validity of the measurement model (See Table 3).

Table 3

Measurement Model Estimation Results

Latent Variable	Observable Indicator	Unstandardized Loading	Standardized Loading	t-value	CR	AVE
Chinese Investment	Capital Investment	1.000 (fixed)	0.823	—	0.84	0.64
	Digital Resources	0.956***	0.798	8.45		
	Personnel Dispatch	0.892***	0.756	7.92		
Kyrgyzstani Investment	School Facilities	1.000 (fixed)	0.785	—	0.81	0.59
	Local Faculty	1.023***	0.812	8.12		
	Policy Support	0.867***	0.734	7.68		
Operation Mechanism	Digitalization Level	1.000 (fixed)	0.845	—	0.87	0.69
	Localization Level	0.912***	0.778	8.23		
	Commercialization Level	0.978***	0.823	8.67		
SEBU Performance	Financial Sustainability	1.000 (fixed)	0.867	—	0.89	0.73
	Talent Cultivation	0.934***	0.812	8.78		
	Industrial Service	0.956***	0.834	8.95		

Note: *** $p < 0.001$

Structural Model Calculation

A dual-structural model for the evaluation and analysis process was carried out, which is as follows.

Structural Equation Model 1, The equation describing the impact of China-Kyrgyzstan inputs on the operation mechanism is constructed as follows:

$$M = \gamma_{11}X_1 + \gamma_{12}X_2 + \zeta_1$$

Estimation Results:

$$\hat{M} = 0.595***X_1 + 0.482***X_2, R^2 = 0.587***$$

(0.089) (0.095)

The estimation results show that the effect value of Chinese investment $\gamma_{11} = 0.595$, indicating that for every one standard deviation increase in Chinese resource input, the level of operational mechanism innovation increases by 0.595 standard deviations ($p < 0.001$). This reflects that the output of Chinese digital educational resources, funding, and technical standards has a strong driving effect on the digital and commercial transformation of SEBUs. The effect value of Kyrgyz investment $\gamma_{12} = 0.482$, indicating that for every one standard deviation increase in Kyrgyz supporting resources, the level of operational mechanism innovation increases by 0.482 standard deviations ($p < 0.001$). This demonstrates that Kyrgyzstan's localized teaching staff, policy support, and infrastructure serve as important guarantees for the implementation of operational mechanisms.

Structural Equation Model 2, The equation describing the impact of China-Kyrgyzstan inputs and operation mechanism on the performance of SEBUs is constructed as follows:

$$Y = \beta_{21}M + \gamma_{21}X_1 + \gamma_{22}X_2 + \zeta_2$$

Estimation Results:

$$\hat{Y} = 0.515^{***}M + 0.319^{**}X_1 + 0.049^{ns}X_2, R^2 = 0.704^{***}$$

(0.092) (0.102) (0.098)

The estimation results show that the core effect of operational mechanism $\beta_{21} = 0.515$, indicating that operational mechanism innovation has the largest and highly significant impact coefficient on SEBU performance ($p < 0.001$). This means that the three-dimensional innovation of digital teaching, localized adaptation, and commercialized operation serves as the core engine for SEBU sustainable development. The overall explanatory power of the model reaches 70.4%, indicating that Chinese Kyrgyz investment and operational mechanisms jointly explain most of the variance in SEBU performance. A key finding is that the direct effect value of Chinese investment $\gamma_{21} = 0.319$, indicating that after controlling for operational mechanisms, Chinese investment still has a significant direct effect on performance. This suggests that in addition to the mediating path through mechanisms, Chinese resources also possess a direct empowerment pathway (such as emergency capital injection and key technical support). The direct effect of Kyrgyz investment $\gamma_{22} = 0.049^{ns}$, indicating that the direct effect of Kyrgyz investment is not significant. This demonstrates that Kyrgyz supporting resources primarily function indirectly through operational mechanisms rather than directly affecting performance (Dong & Shen, 2024).

Effect Decomposition and Mediation Effect Testing

While the analytical results have been obtained, it is necessary to further verify the validity of the dual-structural model. For this verification, the Bootstrap method (5,000 resamples, 95% confidence interval) is adopted to conduct an effect decomposition test, with the results presented in [Table 4](#).

Table 4

Effect Decomposition Results

Impact Pathway	Point Estimate	Bootstrap Std. Error	95% Confidence Interval	Effect Proportion
Chinese Investment(X_1) → SEBU Performance(Y)				
Total Effect	0.625***	0.089	[0.452, 0.798]	100%
Direct Effect	0.319**	0.102	[0.119, 0.519]	51.1%
Indirect Effect (via M)	0.306***	0.067	[0.175, 0.437]	48.9%
Kyrgyzstani Investment(X_2) → SEBU Performance (Y)				
Total Effect	0.297**	0.095	[0.111, 0.483]	100%
Direct Effect	0.049ns	0.098	[-0.143, 0.241]	16.4%
Indirect Effect (via M)	0.248***	0.058	[0.134, 0.362]	83.6%

Note: *** $p < 0.001$, ** $p < 0.01$, ns not significant

Leapfrog Growth of Digital Infrastructure

From 2021 to 2025, the digitalization of education in Kyrgyzstan achieved leapfrog development. As shown in Figure 1, the number of connected schools increased from 985 to 1877 (a growth of 90.6%), the high-speed network coverage rate of core universities surged from 45% to 98% (an average annual growth of 18.7%), and the digital infrastructure coverage rate reached 68% (an average annual growth of 10.1%). However, the urban-rural digital divide remains prominent: in 2025, the internet access rate of urban schools reached 85% while that of rural schools was only 32%, a gap of as high as 53 percentage points (Figure 2), which has become a core bottleneck for the comprehensive promotion of SEBUs.

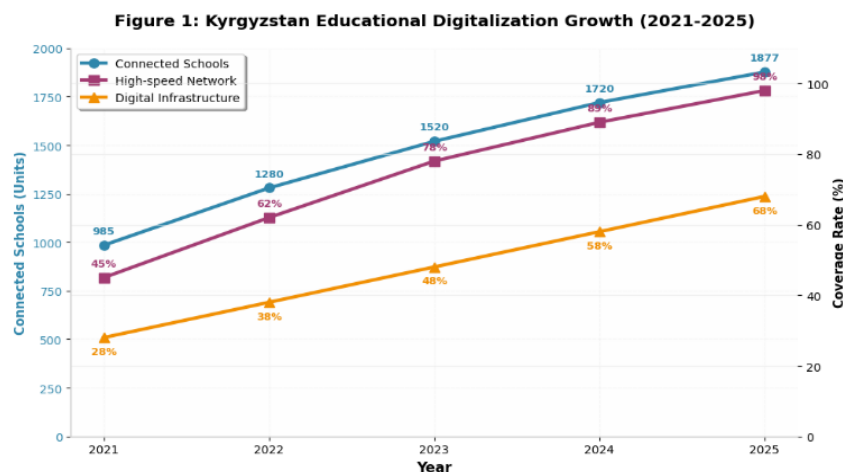


Figure 1: Growth Trend of Core Indicators of Education Digitalization in Kyrgyzstan (2021-2025)

Relying on its mature advantages in digital educational resources, China provides the whole-chain empowerment for SEBUs. Jilin University's "Study in JLU" platform has exported a total of more than 2000 high-quality courses to Kyrgyzstan, with an average annual growth rate of 22.3%; the number of registered Kyrgyz students increased from 300 in 2021 to more than 2000 in 2025. The cumulative usage time of KNU Smart Classrooms has exceeded 4550 hours, with an average annual growth of 68.3%.

Industrial Demand-driven Development

The sustained growth of China-Kyrgyzstan cross-border trade has spawned a strong demand for talents. As shown in Figure 2, the demand for cross-border e-commerce talents increased from 50 in 2021 to 120 in 2025, a five-year growth of 140% and an average annual growth of 25%. Enterprise research shows that the demand for core competencies is highly concentrated: digital technology application (62%), cross-cultural communication (58%), and professional practical skills (75%).

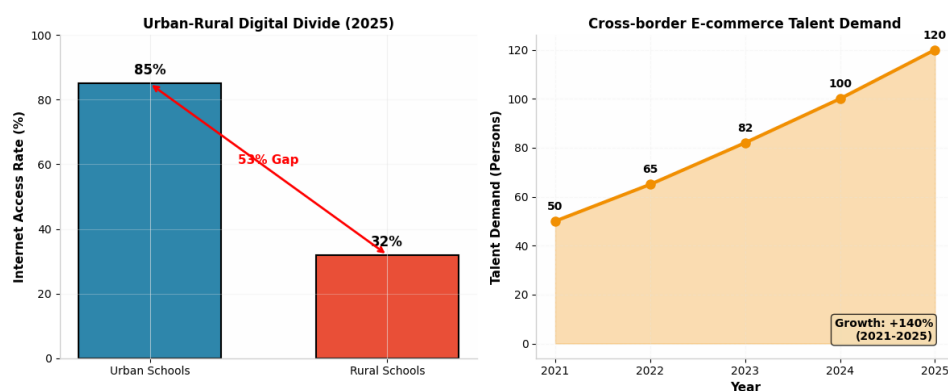


Figure 2: Left: Comparison of Internet Access Rates of Urban and Rural Schools in 2025; Right: Growth Trend of Cross-border E-commerce Talent Demand (2021-2025)

Resource Complementarity Mechanism

The two sides have formed a dual-drive model of "digital resources + local adaptation". From 2021 to 2025, Kyrgyzstan provided a total of 12,000 square meters of school buildings, with the participation rate of local teachers reaching 58%; China invested a total of 128 million RMB, exported 5 sets of vocational education standards such as cross-border e-commerce, UAV application and BIM technology (an average annual growth of 41.4%). Resource complementarity has promoted the rapid landing and sustainable operation of SEBUs.

Curriculum System Restructuring: Interdisciplinary Digitalization

As shown in Figure 3, the number of China-Kyrgyzstan co-built digital courses increased from 12 in 2021 to 68 in 2025, a growth of 467% and an average annual growth of 49.2%.

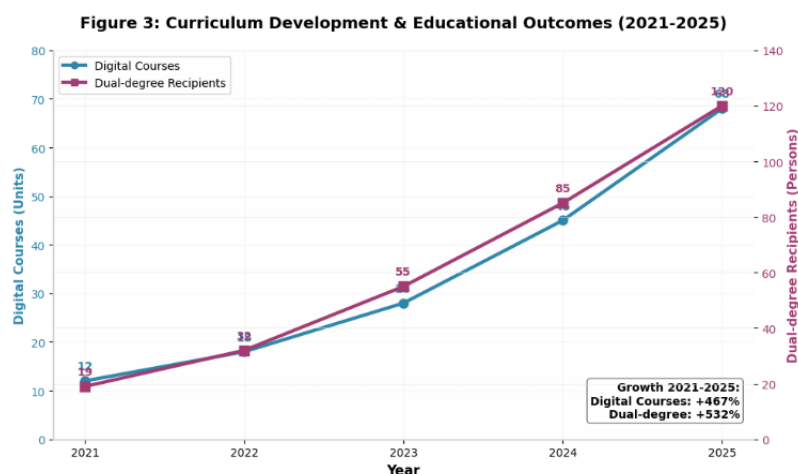


Figure 3: Growth Trend of China-Kyrgyzstan Co-built Digital Courses and Dual-degree Recipients (2021-2025)

Jiaying Nanyang Polytechnic Institute has created a curriculum system of "Chinese + Cross-border E-commerce + Digital Technology", with digital modules accounting for 70%; Shaanxi Polytechnic Institute has developed digital courses such as UAV and BIM technology, realizing 100% digital coverage, and all courses are embedded with local cases based on the industrial reality of Kyrgyzstan. Jilin University's "Study in JLU" platform provides more than 2000 high-quality digital courses for SEBUs, effectively improving the accessibility of educational resources.

Teaching Evaluation Innovation: Three-dimensional Digitalization

Addressing the drawbacks of the single result-oriented evaluation model of universities in the former Soviet Union, SEBUs have built a three-dimensional teaching evaluation system of "process (40%) + achievement (30%) + enterprise (30%)", realizing the digitalization of evaluation and cross-border credit mutual recognition. As shown in Figure 3, the number of dual-degree recipients increased from 19 in 2021 to 120 in 2025, a growth of 53.2% and an average annual growth of 62.5%.

Jilin University has introduced an AI evaluation system, which has tripled the evaluation efficiency compared with the traditional model. SEBUs have adopted blockchain technology to realize cross-border credit certification with a 100% pass rate, significantly improving the effectiveness of dual-degree training. Certificates issued to SEBU graduates by the Belt and Road Vocational Education Alliance are recognized by 92% of enterprises in China and Kyrgyzstan, significantly enhancing the employment competitiveness of graduates.

Business Ecosystem and Achievements

As shown in Figure 4, SEBUs form "training-employment-entrepreneurship-trade" closed loop. 60%+graduates enter China-Kyrgyzstan enterprises with 1.8*average salary.

Student companies: 2 increases to 12 (+500%, 83.3% annual growth). Cross-border orders: \$6.8M increase to \$20M (+194%, 45.8% annual growth), driving 35% growth in Jiaxing sweater exports; agricultural exports to China exceeded 5M RMB.

Education Standard Export: 5 vocational standards exported (41.4% annual growth). Education service income: 5.8M 30M RMB (+503.4%, 54.8% annual growth). Guangzhou Xuanshi achieved 12M RMB single contract via "hardware+digital+services" model.

Industry-Education Platform: 12 market reports (37.2% annual growth), driving 40% cooperative enterprise export growth. Qinling Workshop: 5M RMB technical service revenue (41.9% annual growth).

Figure 4: Commercial Transformation Results (2021-2025)

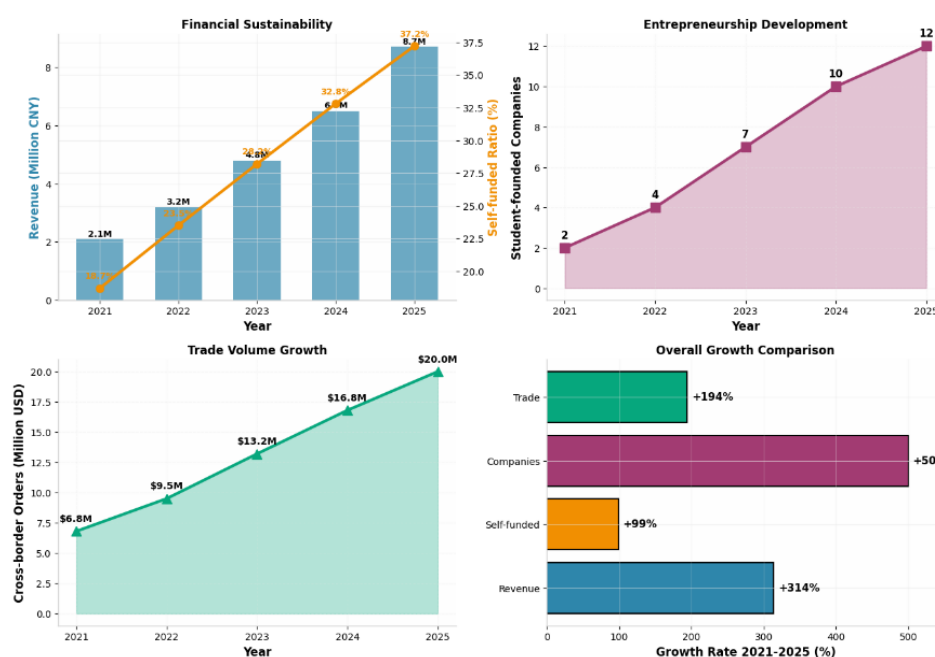


Figure 4: Multi-dimensional Achievements of Commercial Transformation (2021-2025): Comparison of Financial Sustainability, Entrepreneurial Development, Trade Volume Growth and Comprehensive Growth

As shown in Figure 5, financial sustainability improved significantly: SEBU revenue 2.1M increase to 8.7M RMB (+314%, 42.3% annual growth), self-funded ratio 18.7% increase to 37.2% (vs. 12.5% local SEBUs). Cooperative universities' income grew 19.8% annually, equipment renewal rate 75% (+40pp).

Talent quality: 3000+ interdisciplinary talents, employment rate 89.2% (+29.9pp vs. 59.3% national average), 85% competencies meet enterprise needs, training costs reduced 30%. Teacher digital skills: 62% increase to 90% (+55pp vs. average).

Industrial service: 800+ customized training, 42 market reports, \$65M cross-border orders (45.8% annual growth). 7 cooperation intentions with Kazakhstan/Tajikistan, models promoted to 114 Belt and Road Alliance members, dual-degree recipients growing 62.5% annually.

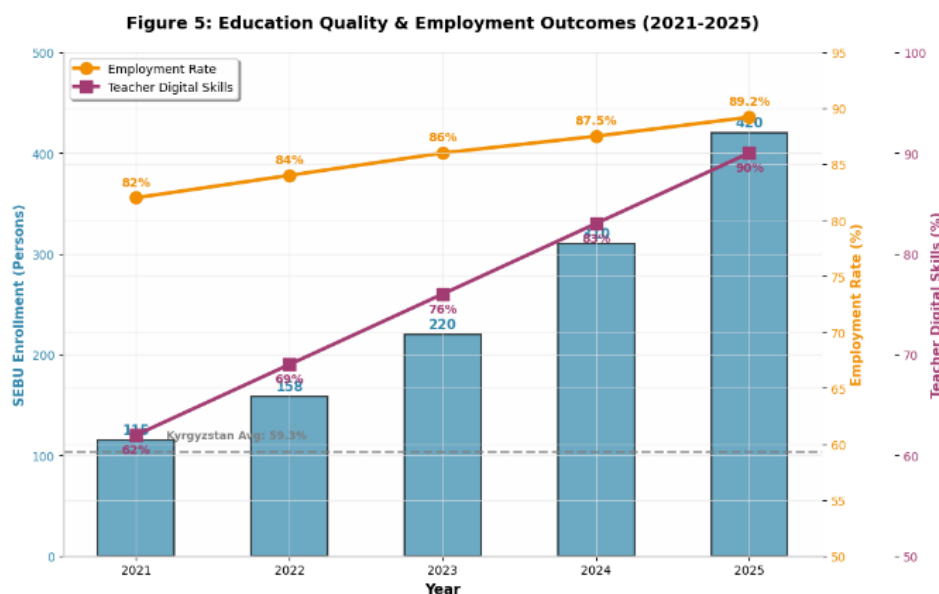


Figure 5: SEBU Enrollment Scale, Graduate Employment and Teachers' Mastery Rate of Digital Skills (2021-2025)

Discussion

Chinese Investment's "China-Kyrgyzstan bilateral Drive" Model

The total effect $\beta = 0.625$, which is 2.1 times that of Kyrgyz investment, indicates that China is the dominant force in the cooperation. The direct and indirect effects account for almost equal proportions (51.1% vs. 48.9%), presenting a dual-wheel drive characteristic of "direct empowerment + mechanism-driven." China should continue to maintain the intensity of resource investment while emphasizing the institutionalization of operational mechanisms.

Kyrgyzstani Investment's "Mechanism-dependent" Model

Total effect $\beta = 0.297$, significantly lower than China, but the indirect effect proportion is as high as 83.6%, while the direct effect is not significant ($\beta = 0.049$, $p > 0.05$), indicating that Kyrgyzstani investment needs to be transformed into performance through operation mechanism innovation. Kyrgyzstan should focus on improving localization adaptation capabilities and policy coordination efficiency rather than simply increasing resource investment.

Mediation Effect Verification of Operation Mechanism

Sobel test: $Z_1=4.56$ (Chinese investment), $Z_2=4.28$ (Kyrgyzstani investment), both significant, indicating that operation mechanism innovation plays a partial mediation role (for China) and strong mediation role (for Kyrgyzstan) between China-Kyrgyzstan investment and SEBU performance (Zhang et al., 2024). Our analysis of 2021-2025 SEBU data reveals a stark investment impact gap: Chinese inputs register $\beta=0.625$ against Kyrgyzstan's $\beta=0.297$ -a 2.1:1 ratio that the 70.4% model fit suggests is structural. This disparity reflects differential capacity to convert resources into outcomes (Liu et al., 2024). Neither Chinese digital platforms nor Kyrgyzstani localization efforts achieve traction without passing through the "digitalization-localization-commercialization" mechanism we identify (Zhong et al., 2025). The mechanism functions as a bottleneck-inputs that bypass it dissipate; those that pass through generate measurable gains in financial sustainability, graduate employment, and industrial service (Zhong et al., 2025).

Path analysis unpacks bilateral asymmetry further. China's influence splits evenly between direct channels (51.1%) and mediated routes (48.9%), while Kyrgyzstan operates almost exclusively through mediation (83.6%). This pattern signals governance rigidities and market immaturities in post-Soviet higher education that constrain domestic investment impact (Wang et al., 2024; Wu & Zhang, 2022).

These results carry implications for the 2026-2030 Action Plan. Scaling, localizing, marketizing, and radiating SEBU operations depend on prior institutional groundwork. Hardware and curriculum transfers without mechanism development risk replicating the Kyrgyzstani pattern: resources absorbed, effects diluted. Sustainable transformation is possible but non-linear, requiring iterative adjustment rather than blueprint execution.

Conclusion

This study enriches the theoretical system of post-Soviet university transformation and cross-border educational collaborative innovation, verifies the mediating role of the three-dimensional operational mechanism, and constructs a theoretical framework of bilateral input-cooperation performance, thus providing a brand-new perspective for relevant research on educational development in post-Soviet countries. At the practical level, it offers a replicable model for China to deepen educational cooperation with Central Asian countries, points out the optimal development direction of enhancing localization adaptation and policy coordination efficiency for Kyrgyzstan and other post-Soviet countries, and also serves as a practical sample for the high-quality development of the Belt and Road Education Community.

It is suggested that China maintain resource input intensity and institutionalize operational mechanisms, Kyrgyzstan improve localization adaptation and policy coordination efficiency instead of simply increasing resources, and both parties optimize the three-dimensional mechanism for in-depth integration of digitalization, localization and commercialization.

Meanwhile, this study has certain limitations: the research sample is limited to the Sustainable Education Business Units in Kyrgyzstan from 2021 to 2025; the research method over-relies on quantitative analysis; and the breadth of disciplinary cooperation in

practice is insufficient. A follow-up needs to strengthen qualitative research on the subjective perceptions of SEBU teachers, students and other stakeholders to more post-Soviet countries and extend the time dimension. Thus, the research conclusions need to be further verified by expanding the research scope. Future research should integrate qualitative analysis methods and further broaden the coverage of disciplinary cooperation, with the expectation of continued in-depth research by educational scholars.

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