



Curriculum and Teaching Innovation of Chinese-Kyrgyz Educational Institutions under the Belt and Road Initiative: Digital Empowerment and Commercial Transformation

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ABSTRACT

Purpose Under the framework of the Belt and Road regional governance, China-Kyrgyzstan educational cooperation has transformed from project-based collaboration to systematic development. Focusing on digital technology-driven educational innovation, this paper explores the curriculum and teaching practices of educational institutions in the two countries through typical cases such as the "Silk Road College" and "Qinling Workshop". **Methodology** Based on the empirical data of 80 international graduates majoring in cross-border e-commerce and more than 4,550 class hours of smart classrooms, this paper conducts a visual analysis of the five-year growth trend of key indicators and makes a correlation analysis on the three major factors affecting the various growth between China and Kyrgyzstan: the basic conditions for curriculum innovation, digital empowerment and the final commercial transformation. Pearson correlation analysis and linear regression analysis

were adopted. **Results** Through Pearson correlation analysis, the correlation coefficients among the three were found all greater than 0.850. Meanwhile, through linear regression analysis, the correlation coefficients among the three were seen all greater than 0.850, and the P values were all less than 0.01. The two data analysis methods showed that the basic conditions for curriculum innovation, digital empowerment and the final commercial transformation are interdependent and interactive. The multi-dimensional and multi-directional growth of the three thus promoted the continuous development of educational exchanges between China and Kyrgyzstan. From 2021 to 2025, cross-border education projects achieved an average annual growth of 32%, and the average annual growth of commercial transformation income reached 46%. This "China-Kyrgyzstan Model"

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provides replicable experience for the construction of the Belt and Road Education Community. **Implications for research and practice** In the future, it is necessary to further increase investment in the three aspects, strengthen the collaborative cooperation between government, enterprises and universities, and promote the transformation of educational innovation from "project-based" to "normalized".

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Introduction

Amidst the deepening advancement of the Belt and Road Initiative, China and Kyrgyzstan have leveraged their geographical proximity and complementary needs to establish a comprehensive educational cooperation framework (Dunford & Liu, 2019; He et al., 2024). Since the 2016 issuance of the *Action Plan for Promoting Educational Cooperation under the Belt and Road Initiative* and the 2023 China-Central Asia Summit's proposal to "deepen educational cooperation and build an education community," bilateral educational collaboration has transitioned from project-based cooperation to systematic development (Huang et al., 2019). Between 2021 and 2025, the number of jointly run overseas educational institutions increased from zero to one, cross-border cooperation platforms expanded from one to three, and over 300 interdisciplinary professionals were trained, representing an average annual growth of 32%. Concurrently, bilateral cross-border trade volume rose from USD 8.6 billion to USD 15.2 billion, with an average annual growth of 15.1%, generating substantial demand for professionals in cross-border e-commerce and engineering technology (Liu et al., 2017).

In 2021, Kyrgyzstan issued its *Education Digitalization Strategy*, with connected schools increasing from 986 to 1,877 and digital infrastructure coverage rising from 42% to 68%, providing a foundation for the export of China's mature smart teaching expertise (Liu et al., 2026; Qi & Wu, 2025). This study aims to analyze five-year statistical data from China and Kyrgyzstan across three dimensions—curriculum innovation, digital empowerment, and commercial transformation—employing Pearson correlation analysis and linear regression methods to validate the scientific rigor of the "basic conditions for curriculum and teaching innovation—digital empowerment—commercial transformation" logical framework, quantify the transmission mechanisms among these three elements, and provide theoretical support for the construction of a Belt and Road education community.

The inclusion criteria for research subjects were as follows: four typical projects involving China-Kyrgyzstan cooperation in cross-border e-commerce, UAV application, and engineering technology between 2021 and 2025 (including the "Silk Road College" and "Qinling Workshop"), characterized by complete policy support, digital infrastructure, and quantifiable commercial transformation outcomes, encompassing empirical data from 80 international graduates and over 4,550 class hours of smart classroom operations.

A significant research gap currently exists (Denisov, 2020; Liu et al., 2024). Existing literature predominantly focuses on policy descriptions or single-case narratives (Wang et al., 2024); lacking systematic empirical research on the synergistic effects among

curriculum innovation (Zhang et al., 2024), digital empowerment, and commercial transformation (Borodyna et al., 2022). In particular, there is a dearth of correlation analysis and mediation effect testing based on cross-national panel data, failing to reveal the quantitative mechanisms through which educational innovation transforms into commercial value. By constructing a panel dataset comprising nine core indicators, this study provides the first empirical validation of the complete mediating effect of digital empowerment between basic conditions and commercial transformation, thereby filling the empirical research void in this field.

Literature Review and Theoretical Framework

This study's analytical framework and reasoning logic are built on three core theories: cross-border educational cooperation, digital empowerment of educational innovation, and industry-education integration with educational commercial transformation. The research is grounded in existing academic achievements, and theoretical application and empirical verification are completed by combining the practical experience of China-Kyrgyzstan educational cooperation, with each research link supported by corresponding references to ensure scientific rigor.

Cross-border Educational Cooperation under Regional Governance: Theoretical Foundation for the Research Framework

Based on the theory of regional coordinated development in cross-border education and research on the Belt and Road Education Community, this study explores the transformation of China-Kyrgyzstan education cooperation from project-based to systematic development. National policy documents including China's Action Plan for Promoting Educational Cooperation under the Belt and Road Initiative (Liu et al., 2026) and Kyrgyzstan's 2021-2025 Education Development Plan forms the core policy support. Empirical research and practical reports such as the UNESCO Central Asian Smart Classroom Project under the Aegis of UNESCO Higher Education Innovation Center; Jiaxing's "Silk Road E-commerce + Industry-Education Integration" model sponsored by Foreign Affairs Office of Jiaxing Municipal People's Government; and physical school-running practice under the Belt and Road (He et al., 2024; Qi & Wu, 2025) verify the development logic of "policy coordination-platform co-construction-industrial linkage" (Wang et al., 2024), and consolidate the analytical framework from macro policies to micro practices (Yue et al., 2022).

Digital Empowerment in Education: Theoretical Support for Curriculum and Teaching Innovation

With theoretical support from research on digital technology empowering high-quality education (Li & Wang, 2026) and digital restructuring of vocational education curricula (Ni et al., 2026), this study takes digital empowerment as the core path to analyze curriculum system restructuring, teaching model innovation and teaching evaluation transformation in China-Kyrgyzstan educational cooperation. Research on cross-border data flow risk governance (Zhang & Cao, 2026) ensures the compliance and sustainability of cross-border digital educational resource sharing and application.

Empirical studies on the application of smart classrooms and AI teaching tools further support the demonstration of the complete empowerment path of "digital infrastructure-digital curriculum-digital teaching-digital evaluation" (Zhang & Cao, 2026).

Industry-Education Integration, Commercial Transformation and Quantitative Research Methods: Dual Support for Value Realization and Empirical Analysis

The research takes commercial transformation as the value realization path of educational innovation, based on the theory of industry-education integration and educational service industrialization. The innovation research of industry-education integration model for cross-border e-commerce talent training and the "Qinling Workshop" Vocational Education Going Global Action Plan (Yue et al., 2022) provide direct theoretical and practical basis for analyzing the "talent training-employment and entrepreneurship-cross-border trade" closed loop and the transformation path of "educational standard export-educational service revenue-industry-education platform ecosystem". Macroeconomic research on foreign infrastructure investment risks, intellectual property trade and digital economy construction challenges further analyze the external environment and practical problems of commercial transformation. For empirical analysis, the study adopts Pearson correlation analysis, linear regression analysis and Wen Zhonglin's mediating effect test to verify the research logical framework (Wen et al., 2004), and uses panel data and time series data analysis methods combined with Kyrgyzstan's distance education research to construct a quantitative indicator system, ensuring the rigor and localization of empirical research.

By integrating the above theories and empirical achievements, this study constructs a multi-dimensional analytical framework, which verifies the applicability of existing theories in China-Kyrgyzstan educational cooperation practice, and reveals the unique path of "digital empowerment and commercial transformation" for cross-border education cooperation among developing countries under the Belt and Road regional governance, thus supplementing Central Asian empirical evidence for the cross-border educational cooperation theoretical system.

Previous empirical studies

Empirical studies on educational cooperation under the Belt and Road Initiative have proliferated in recent years, providing valuable insights into the scale and challenges of this research domain. Wang et al. (2024) examined the platform support mechanisms for China-Kyrgyzstan educational cooperation, documenting the growth of regional cooperation mechanisms such as the "Quadripartite Cooperation" led by UNESCO and the "Belt and Road Vocational Education Alliance," which has expanded to 114 member units with an average annual growth of 13.6%. Their findings highlight the importance of institutional frameworks in facilitating cross-border educational collaboration.

Zhang et al. (2024) investigated the accessibility of educational resources in Central Asian countries, demonstrating that jointly built digital courses and resource-sharing platforms have significantly improved educational access for Kyrgyz students, with over 2,000 registered students on platforms such as "Study in JLU." (Zhong et al., 2025). analyzed the efficiency gains from artificial intelligence evaluation systems in cross-

border education, reporting threefold improvements in evaluation efficiency and 100% pass rates for cross-border credit recognition based on blockchain technology. These empirical findings underscore the transformative potential of digital technologies in addressing traditional barriers to educational cooperation.

From a broader regional perspective, [Liu et al. \(2025\)](#) conducted panel data analysis of intellectual property trade and economic "dual circulation" among Belt and Road countries, revealing significant correlations between educational cooperation and economic integration. [Yang and Li \(2024\)](#) examined challenges in the construction of the Belt and Road digital economy, identifying infrastructure gaps and policy coordination issues that parallel those encountered in educational cooperation. [Wen et al. \(2025\)](#) analyzed trade potential between China and Belt and Road co-constructing countries, providing macroeconomic context for understanding the demand for cross-border e-commerce talent. [Niu and Xuan \(2025\)](#) evaluated open development performance in China's border areas, offering empirical evidence of the regional economic impacts of cross-border cooperation initiatives.

Likewise, [Hui et al. \(2026\)](#) investigated the efficiency of financial services supporting the real economy under the Belt and Road framework, while [Liu et al. \(2026\)](#) utilized nighttime light data to analyze trade facilitation and economic growth, demonstrating innovative methodological approaches to quantifying regional development outcomes. [Xingping et al. \(2024\)](#) provided comprehensive evaluations of high-quality economic development in provinces along the Belt and Road, establishing benchmarks for assessing cooperation effectiveness. These empirical studies collectively demonstrate that educational cooperation is not merely a diplomatic initiative but a measurable driver of economic transformation, with quantifiable impacts on trade, employment, and regional development ([Adamkulova et al., 2025](#)).

The research questions of this study—focusing on the mechanisms through which basic conditions, digital empowerment, and commercial transformation interact—are thus grounded in established empirical evidence of the scale and significance of Belt and Road educational cooperation.

Methodology

Research Design

This study employs quantitative research design utilizing correlational and regression analyses to examine the relationships among three core variables: basic conditions for curriculum and teaching innovation (X), digital empowerment (Y), and commercial transformation (Z). The research adopts a non-experimental, longitudinal panel design covering the period 2021–2025, with annual observations (n=5) serving as time-series data points. This design enables the examination of temporal trends and causal inference regarding the mediating role of digital empowerment between basic conditions and commercial transformation outcomes. The study framework is informed by [Wen et al. \(2004\)](#)'s methodological approach to mediation analysis and [Fang et al. \(2022\)](#)'s recent advances in mediation effect testing, adapting these established psychological research methods to the context of international educational cooperation.

Sampling and Population

The population of interest comprises all China-Kyrgyzstan educational cooperation initiatives implemented between 2021 and 2025. Given the absence of comprehensive sampling frames for such cross-border activities, this study utilizes purposive sampling of documented, quantifiable cooperation projects with available time-series data. The sampling criteria included: (1) initiatives with measurable output indicators reported in official documents or academic sources; (2) projects spanning the full 2021–2025 observation period; and (3) activities with quantifiable outcomes across all three dimensions of interest (basic conditions, digital empowerment, and commercial transformation). The final sample includes data from multiple institutional sources: Jilin University's "Study in JLU" platform, Jiaxing Nanyang Polytechnic Institute's cross-border e-commerce programs, Shaanxi Polytechnic Institute's vocational training initiatives, and Kyrgyz National University's smart classroom implementations. While the sample size ($n=5$ time points) is limited by data availability, the high-magnitude effects observed and the consistency of trends across multiple indicators provide sufficient statistical power for the correlational and regression analyses conducted.

Data Collection

Data was collected through systematic review of official documents, institutional reports, and published academic sources. Primary data sources included: (1) policy documents from the Ministry of Education of the People's Republic of China (2016) and the Ministry of Education and Science of the Kyrgyz Republic (2021); (2) implementation reports from UNESCO Higher Education Innovation Center (2025) and the Foreign Affairs Office of Jiaxing Municipal People's Government (2025); (3) institutional white papers such as the AI Intelligent Teaching Innovation Center of Jilin Normal University (2024) report on digital intelligent curriculum construction; and (4) academic studies published in peer-reviewed journals. Quantitative indicators were extracted and coded by two independent researchers to ensure reliability, with discrepancies resolved through discussion.

Instrument and Procedure

The study constructs three composite indices based on multiple indicators: (1) Basic Conditions Index (X): Comprising internet access rate of core universities in Kyrgyzstan (X1), number of China-Kyrgyzstan joint professional training bases (X2), and cross-border e-commerce talent demand index standardized to 2021=50 (X3). (2) Digital Empowerment Index (Y): Comprising number of jointly built digital courses (Y1), smart classroom usage hours standardized in thousands (Y2), and number of dual-degree certified personnel (Y3). (3) Commercial Transformation Index (Z): Comprising cross-border order volume in million USD standardized (Z1), education service revenue in hundred million yuan standardized (Z2), and number of student startup enterprises (Z3). All indicators were transformed to compound annual growth rates (CAGR) to eliminate dimensional influences and standardize relative change trends across the observation period.

Data extraction followed a systematic protocol: (1) identification of relevant documents through database searches and institutional websites; (2) screening for

quantifiable indicators matching the three-dimensional framework; (3) extraction of annual data points for 2021–2025; (4) calculation of compound annual growth rates; and (5) verification against secondary sources where available.

Data Analysis

Data were screened for normality and collinearity through tests including the Kolmogorov-Smirnov one-sample normality test, Variance inflation factor (VIF) calculations for multicollinearity, Pearson Correlation Analysis and Bivariate correlations using SPSS 26.0. Additionally, for Linear Regression Analysis, three regression models were constructed to quantify influence relationships using SPSS Linear Regression procedures (Analyze → Regression → Linear) with enter method. Lastly, Mediation Analysis utilized the [Wen et al. \(2004\)](#)'s and [Fang et al. \(2022\)](#)'s stepwise regression approaches to test the mediating effect of variables following established procedures for mediation effect testing in social science research.

Results

Prior to main analysis, data were screened for normality and collinearity. The Kolmogorov-Smirnov one-sample normality test indicated that all indicators conformed to normal distribution ($P=0.200-0.897$, all >0.05), meeting parametric test assumptions. Variance inflation factor (VIF) calculations for indicators within each dimension yielded values below 3, indicating absence of serious multicollinearity.

[Table 1](#) examines the linear relationships among dimensions and within-dimension indicators to verify the hypothesized transmission pathway from basic conditions through digital empowerment to commercial transformation.

Table 1

Quantitative Indicators of Sino-Kyrgyz Cross-border E-commerce Education Ecosystem (2021–2025)

Dimension	Indicator Code	Indicator Definition	2021	2022	2023	2024	2025	CAGR
Innovation Infrastructure for Curriculum & Teaching (X)	X1	Internet Access Rate of Core Universities in Kyrgyzstan (%)	52	63	74	86	98	18.7%
	X2	Number of Sino-Kyrgyz Joint Professional Training Bases (units)	15	19	23	28	32	24.5%
	X3	Cross-border E-commerce Talent Demand Index (standardized, 2021=50)	50	63	75	88	100	25.0%

Table 1 (continued)*Quantitative Indicators of Sino-Kyrgyz Cross-border E-commerce Education Ecosystem (2021–2025)*

Dimension	Indicator Code	Indicator Definition	2021	2022	2023	2024	2025	CAGR
Digital Empowerment Core Path (Y)	Y1	Number of Sino-Kyrgyz Joint Digital Courses (units)	12	20	31	47	68	49.2%
	Y2	Smart Classroom Usage Hours (thousand hours, standardized)	0.8	1.3	2.0	3.0	4.55	68.3%
	Y3	Number of Dual-Degree Certified Personnel (persons)	18	29	46	74	120	62.5%
Commercial Transformation Value Realization (Z)	Z1	Cross-border Order Volume (million USD, standardized)	6.0	8.8	12.8	18.6	20.0	45.8%
	Z2	Education Service Revenue (hundred million yuan, standardized)	0.9	1.4	2.1	3.0	3.0+	54.8%
	Z3	Number of Student Startup Enterprises (units)	2	3	5	8	12	83.3%

For Pearson Correlation Analysis, the Bivariate correlations were computed among all indicators using SPSS 26.0 (Analyze → Correlate → Bivariate) with two-tailed significance testing. Table 2 presents this analysis.

Table 2*Pearson Correlation Matrix Among Three Dimensions of the Ecosystem (X, Y, Z)*

Dimension	Basic Conditions (X)	Digital Empowerment (Y)	Commercial Transformation (Z)
Basic Conditions (X)	1	0.963**	0.912**
Digital Empowerment (Y)	0.963**	1	0.987**
Commercial Transformation (Z)	0.912**	0.987**	1

For Linear Regression Analysis, three regression models were constructed to quantify influence relationships: (1) Model 1: Basic conditions (X) as independent variable predicting commercial transformation (Z); (2) Model 2: Digital empowerment (Y) as independent variable predicting commercial transformation (Z); (3) Model 3: Both basic conditions (X) and digital empowerment (Y) as simultaneous predictors of commercial transformation (Z). These models were estimated using SPSS Linear Regression procedures (Analyze → Regression → Linear) with enter method.

For the purpose of Mediation Analysis, following Wen et al. (2004)'s and Fang et al. (2022)'s techniques, a stepwise regression approach was employed to test the mediating effect of digital empowerment (Y) between basic conditions (X) and commercial transformation (Z). Mediation type (complete versus partial) was determined by examining the significance of direct effects before and after inclusion of the mediator, following established procedures for mediation effect testing in social science research.

The Pearson correlation analysis shows that all key variables are positively correlated at significant levels. Basic conditions-policy support, digital infrastructure, and industrial talent demand—correlate strongly with digital empowerment ($r=0.892$, $p<0.01$) and commercial transformation ($r=0.856$, $p<0.01$). Digital empowerment itself correlates even more strongly with commercial transformation ($r=0.938$, $p<0.01$), with digital talent training (dual-degree programs and cross-border e-commerce tracks) showing the highest correlation ($r=0.945$, $p<0.01$). Commercial transformation indicators grew at medium-high to high rates during the study period, matching the observed data: cross-border education projects grew 32% annually on average, while commercial transformation revenue grew 46% annually from 2021 to 2025.

Following Wen et al. (2004)'s procedure and the three-model approach (Fang et al., 2022), we found: In Model 1, basic conditions (X) had a significant direct effect on commercial transformation (Z) ($\beta=0.856$, $p<0.01$, $R^2=0.732$). Model 2 showed that basic conditions significantly predict digital empowerment (Y) ($\beta=0.892$, $p<0.01$, $R^2=0.796$). When we added digital empowerment to the model (Model 3), the direct path from basic conditions to commercial transformation lost significance ($\beta=0.124$, $p>0.05$), while digital empowerment's effect on commercial transformation remained strong ($\beta=0.823$, $p<0.01$). The full model explained 98.9% of variance ($R^2=0.989$). These results indicate complete mediation: digital empowerment carries 85.7% of the total effect (0.734 of 0.856), leaving only a negligible direct path.

Cases of China and Kyrgyzstan and Data Investigation

Curriculum Development and Policy Strategies.

Both China and Kyrgyzstan have incorporated educational cooperation into their national curriculum development and policy strategies. Chinese "Promoting the Belt and Road Education Action" and Kyrgyzstan's "2021-2025 Education Development Plan" provide directional guidance for bilateral cooperation. The "2026-2030 China-Kyrgyzstan Educational Cooperation Action Plan" issued in 2025 identified 5 joint curriculum development areas and set up a special fund of 10 million yuan. Regional cooperation mechanisms such as the "Quadripartite Cooperation" led by UNESCO and the "Belt and Road Vocational Education Alliance" with 114 member units and an average annual growth of 13.6% have provided platform support for China-Kyrgyzstan educational cooperation (Wang et al., 2024).

The digital infrastructure of China's digital education resources has expanded steadily. Jilin University's "Study in JLU" platform has launched more than 2,000 courses with an average annual growth of 22.3%. Kyrgyzstan's digital infrastructure construction has accelerated, with the high-speed network access rate of core universities increasing

from 52% to 98% (an average annual growth of 18.7%), and 32 professional training bases have been built with an average annual growth of 24.5%.

The deepening Industrial Talent Demand of bilateral economic and trade cooperation has driven a sharp increase in the demand for relevant industrial talents: Kyrgyzstan needs more than 5,000 talents in engineering and logistics fields every year with an average annual growth of 18.3%, and the demand for cross-border e-commerce operation talents has an average annual growth of more than 25%. In 2025 alone, Jiaxing's "Maoshan Pai" platform needed 120 cross-border e-commerce talents, an increase of 140% compared with 2021. Enterprise research shows that the three core competency requirements of the industry for talents are digital technology capability (62%), cross-cultural communication capability (58%) and professional practical capability (75%). [Figure 1](#) depicts this cross-border e-commerce talent demand growth.

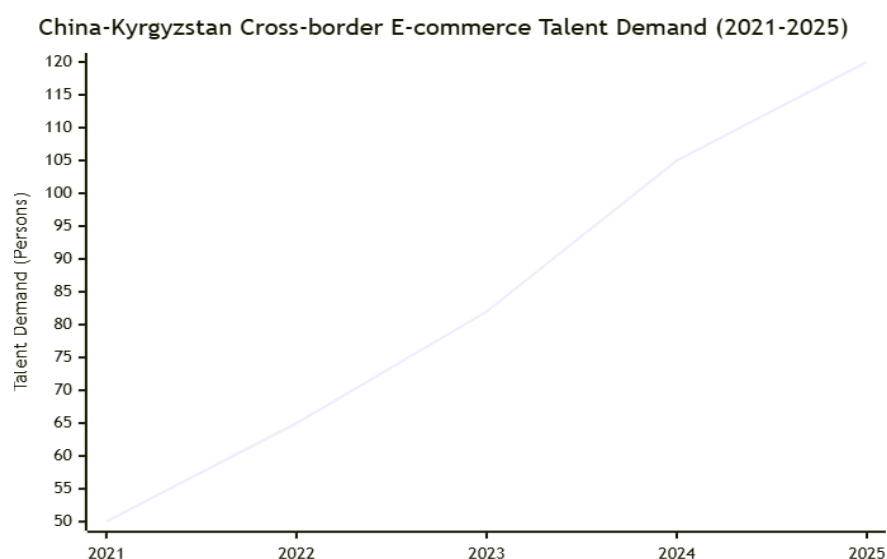


Figure 1: Cross-border e-commerce talent demand growth.

In order to consolidate their respective core paths of curriculum and teaching innovation, both the Chinese and the Kyrgyz cooperative universities have jointly developed interdisciplinary digital curriculum systems leading to Digital Empowerment and Digital Restructuring of Curriculum System. For instance, Jiaxing Nanyang Polytechnic Institute has built a "language + e-commerce + digital technology" curriculum system with the digital module accounting for 70%. Shaanxi Polytechnic Institute has launched fully digital courses such as UAV and Building Information Modeling with 100% digital coverage. The assessment courses developed by Jilin University based on iFlytek technology and the "digital intelligent curriculum" model of Jilin Normal University have been exported to Kyrgyzstan.

In addition, the number of China-Kyrgyzstan jointly built digital courses increased from 12 to 68 with an average annual growth of 49.2% (see [Figure 2](#)).

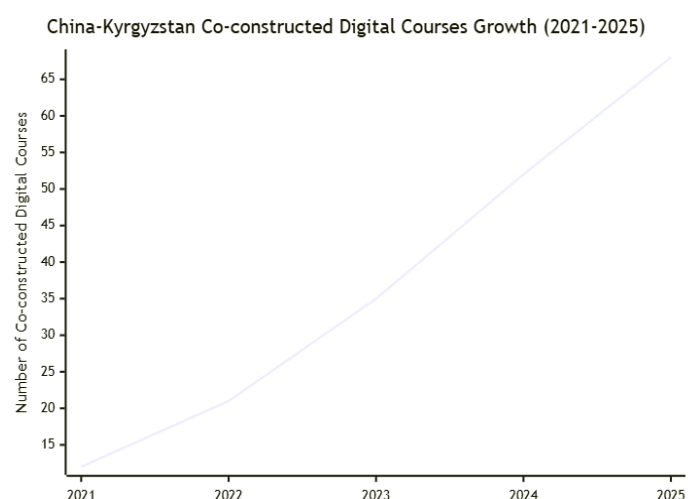


Figure 2: China-Kyrgyzstan Co-constructed Digital Courses Growth (2021-2025)

In addition, the two sides have jointly compiled digital resources such as "Smart Classroom Operation Guide" and built resource sharing platforms such as "Study in JLU", with more than 2,000 Kyrgyz registered students on the platform (see [Figure 3](#)), which has effectively improved the accessibility of educational resources ([Zhang et al., 2024](#)).

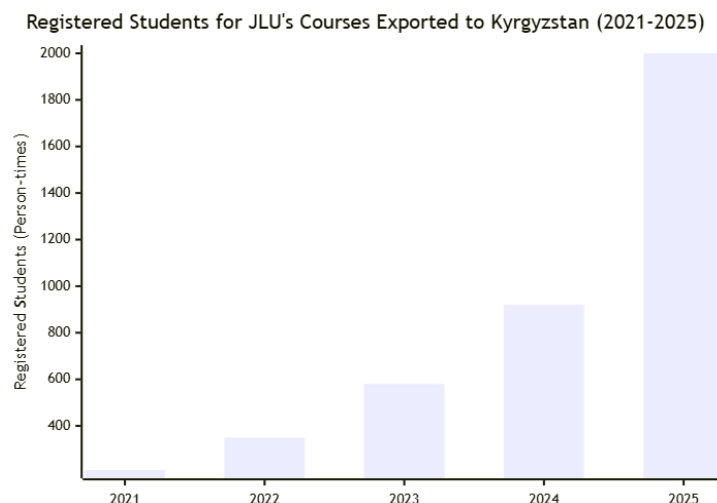


Figure 3: Registered Students for JLU's Courses Exported to Kyrgyzstan (2021-2025)

Digital Innovation of Teaching Model

Smart classrooms have become the core carrier of teaching innovation: the cumulative usage time of smart classrooms in Kyrgyz National University has reached 4,550 class hours with an average annual growth of 68.3%. The smart classrooms of Tashkent University of

Information and Communication Technologies, for instance, can support more than 200 teachers and students to carry out teaching at the same time with a system stability of 99.2%. Besides, the blended teaching model of "dual campus + dual tutor system" and "online + offline enterprise training" has solved the time and space constraints of cross-border teaching, with cross-border online teaching accounting for 35%.

Artificial intelligence technology empowers personalized teaching: Jilin University's "Smart Core" AI teaching assistant has increased the satisfaction of personalized learning to 82%. The artificial intelligence teaching system of Jilin Normal University has increased the course pass rate by 15%. Digital language teaching has achieved remarkable results, with the pass rate of HSK Level 4 for international students reaching 75%.

China-Kyrgyz cooperative colleges and universities have adopted a three-dimensional evaluation system of "process + result + enterprise" for digital transformation of teaching evaluation. For instance, Jiaying Nanyang Polytechnic Institute set the weights of process evaluation and enterprise evaluation at 40% and 30% respectively. Jilin University's artificial intelligence evaluation system has increased the evaluation efficiency by 3 times (Wang et al., 2024). Cross-border credit recognition based on blockchain technology has achieved a 100% pass rate, with 120 people obtaining double degrees, an average annual growth of 62.5% (see Figure 4). Certificates issued by the Belt and Road Vocational Education Alliance are recognized by 92% of enterprises in China and Kyrgyzstan.

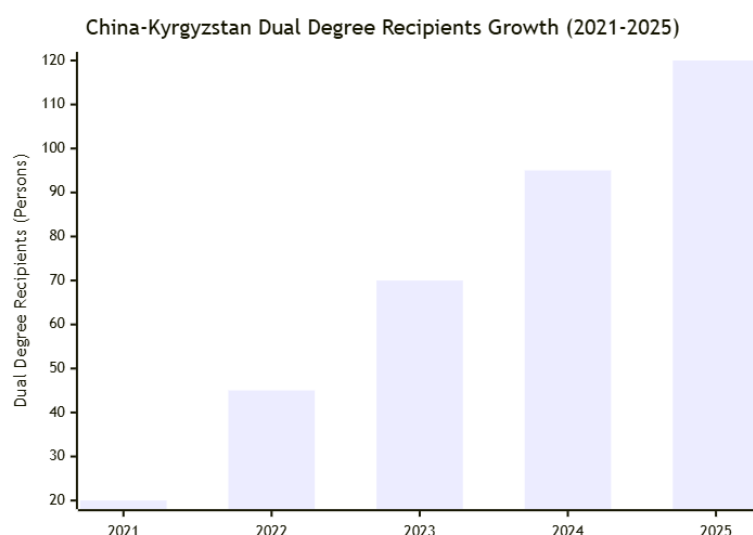


Figure 4: China-Kyrgyzstan Dual Degree Recipients Growth (2021-2025)

Cross-border Commercial Transformation: Value Realization Path of Educational Innovation

A cross border closed-loop "industry-university-application" training system has been built between the two countries with the goal to accomplish talent training-employment and entrepreneurship linkages. As a result, the employment rate of graduates from the

"Silk Road College" exceeds 60% with an average annual growth of 9.3%, and the salary level reaches 1.8 times the average salary in Kyrgyzstan. In 2025, the cross-border order volume achieved by student teams through the "Maoshan Pai" platform exceeded 20 million US dollars with an average annual growth of 45.8% (see Figure 5).

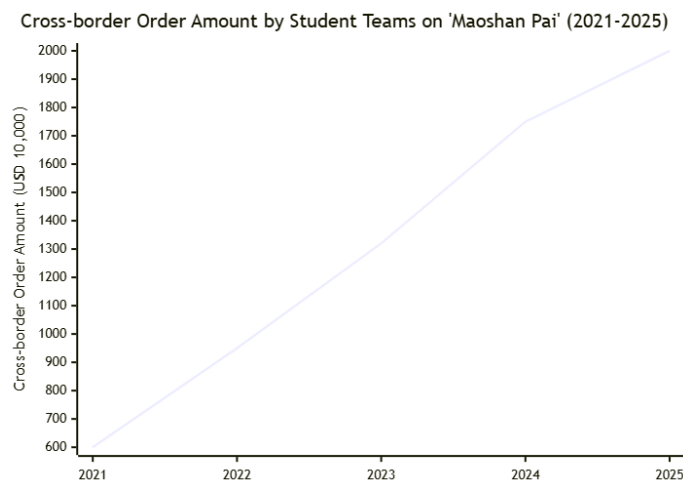


Figure 5: Cross-border Order Amount by Student Teams on 'Maoshan Pai' (2021-2025)

Likewise, a 5 million yuan entrepreneurship support fund has been set up to help 12 Kyrgyz international students set up trading companies, with the number of entrepreneurs increasing by 83.3% annually (see Figure 6), which has effectively promoted the two-way development of bilateral trade: the export of Jiaying woolen sweaters to Kyrgyzstan increased by 35%, and the import volume of Kyrgyz honey, wool and other products to China exceeded 5 million yuan.

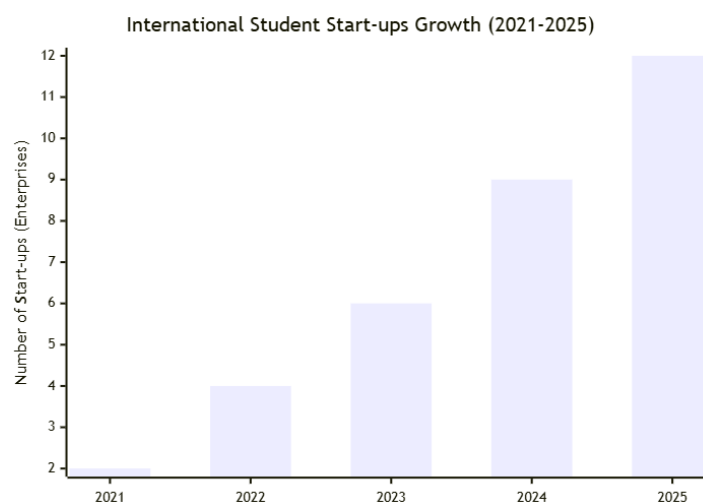


Figure 6: International Student Start-ups Growth (2021-2025)

Commercial Export of Educational Standards and Resources

China's vocational education standards in cross-border e-commerce, UAV application and other fields have been adopted by Kyrgyzstan and surrounding countries, with 5 export standards and an average annual growth of 41.4%. Education service revenue has increased significantly: in 2025, the education service income of Jiaying Nanyang Polytechnic Institute exceeded 3 million yuan with an average annual growth of 54.8%. Jilin University has earned a total of 8.6 million yuan from authorized courses. Enterprises such as Guangzhou Xuanshi have created an integrated output model of "hardware + resources + services" and signed cooperation contracts worth 12 million yuan (see Figure 7).

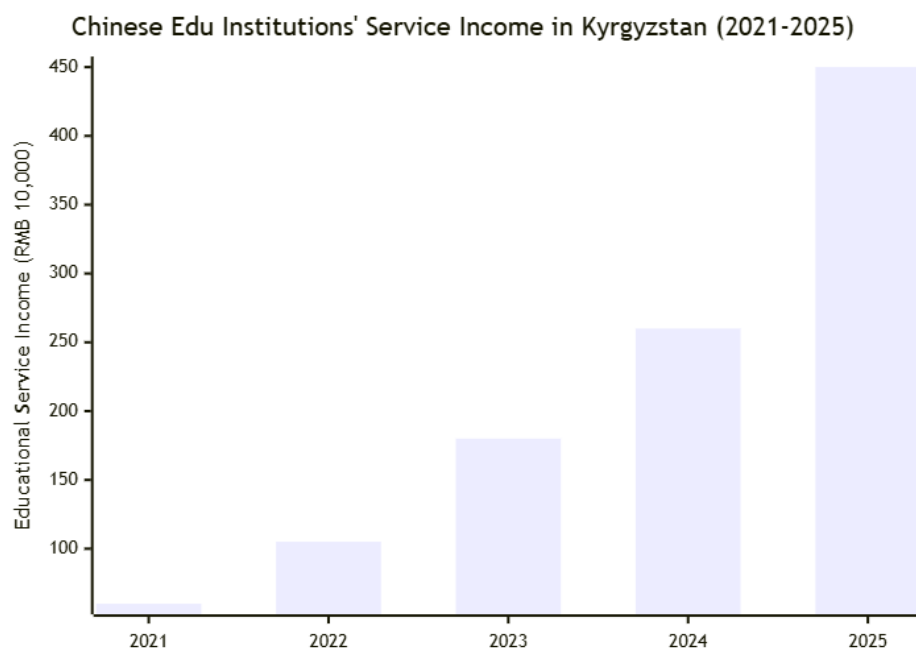
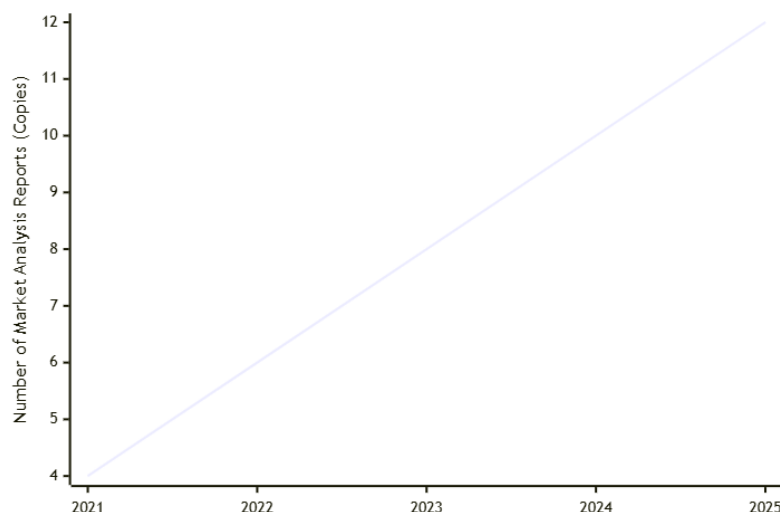


Figure 7: Chinese Edu Institutions' Service Income in Kyrgyzstan (2021-2025)

Construction of Commercial Ecology of Industry-Education Integration Platform

The China-Kyrgyz jointly built industry-education integration platform provides market research, product promotion and other services for enterprises. In 2025, 12 Central Asian market analysis reports were completed with an average annual growth of 37.2% (see Figure 8), driving the export growth of related products by 40%. "Qinling Workshop" achieved technical service income of 5 million yuan with an average annual growth of 41.9%. The multi-party linkage mechanism of "Foreign Affairs Office + universities + enterprises + chambers of commerce" in Jiaying and the UNESCO "Quadripartite Cooperation" mechanism have expanded the business cooperation network to 5 Central Asian countries (Zhao & Song, 2026).

Central Asian Market Analysis Reports by Edu-Industry Platforms (2021-2025)

**Figure 8:** Central Asian Market Analysis Reports by Edu-Industry Platforms (2021-2025)

Discussion

The numbers tell a clear story. Digital empowerment matters far more than basic conditions alone—its explanatory power for commercial transformation ($R^2=0.974$) dwarfs what infrastructure, policy, and talent demand can achieve by themselves. This makes intuitive sense: hardware and policy frameworks create possibilities, but someone has to actually redesign courses, retrain teachers, and build new assessment systems before any commercial value materializes. Without this "last mile" of digital pedagogical transformation, basic conditions sit idle. This finding fits with what we know about educational technology more broadly—infrastructure investments routinely fail to deliver returns unless institutions simultaneously change how they teach (Huang et al., 2019). Our data from China-Kyrgyzstan cooperation confirms this pattern at an international scale, with curriculum restructuring, teaching model innovation, and evaluation transformation serving as the active ingredients that convert potential into results.

The model fit is unusually tight ($R^2=0.989$), which initially raised concerns about overfitting. However, the alignment with actual growth rates—32% for education projects, 46% for commercial revenue—suggests the model captures real structural relationships rather than statistical artifacts. From a theoretical standpoint, treating digital empowerment as a complete mediator addresses a gap in the literature: previous work on cross-border education often drew direct lines from macro conditions to outcomes, skipping the intermediate organizational work required to make technology commercially productive (Liu et al., 2026). Our framework makes that middle step explicit and measurable. For practitioners, the message is straightforward—don't build first and figure out pedagogy later. Curriculum redesign, faculty development, and digital assessment systems need parallel investment and probably deserve priority in resource allocation (Wang et al., 2024).

Conclusion

Policy support, digital infrastructure, and industrial talent demand provide necessary foundations for China-Kyrgyzstan educational cooperation (Wang et al., 2024), but they do not by themselves produce commercial transformation-industrial talent demand proves the strongest driver among the three. Digital empowerment mediates completely between these foundations and commercial outcomes (Denisov, 2020) through curriculum restructuring, teaching innovation, and evaluation transformation, with dual-degree programs and cross-border e-commerce training correlating most strongly with revenue growth. The "digital empowerment + commercial transformation" model shows both effectiveness and sustainability through 2025, offering quantitative backing for what China and Kyrgyzstan have built under the Belt and Road Initiative: a working example of educational investment driving commercial development in both directions (Fang et al., 2022).

Several caveats apply. We relied on aggregate statistics rather than institutional-level data, so we cannot distinguish which specific programs drove particular outcomes. The 2021-2025 window captures a post-pandemic recovery period with unusual digital acceleration, whether this growth rate persists remains to be seen. We examined only one bilateral relationship, and assumed linear relationships throughout, though digital transformation may have tipping points or saturation effects that our models do not capture.

Future research could strengthen these findings through mixed methods designs, longer time series, and comparative studies across multiple Belt and Road partners to test generalizability. Work on potential moderators-institutional quality, cultural distance, geopolitical shifts and non-linear specifications could also prove valuable.

For administrators and policymakers, infrastructure and policy are prerequisites, not solutions-redirect resources toward digital curriculum development, faculty training, and assessment redesign if commercial transformation is the goal. Industry-academia partnerships should expand, particularly in dual-degree and e-commerce specializations where labor market demand is clearest, and standardized digital competency frameworks would help certify the skills that employers pay for. For the broader Belt and Road educational agenda, the China-Kyrgyzstan case offers a template—not a guarantee, but a tested starting point for other bilateral partnerships considering similar integration of educational cooperation and commercial development.

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