

Article

Effectiveness Evaluation of the Group-Based Paired Education Assistance Program between Shanghai and Yunnan

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Abstract: Group-oriented educational assistance constitutes a vital institutional innovation meant to boost balanced high-quality regional education within east-west collaborative frameworks. Traditional performance assessment approaches mostly focus on indicator weighting and ranking outputs, which fail to reveal how multiple interacting conditions jointly produce satisfactory assistance outcomes. This paper takes Shanghai-Yunnan group-based high-school educational pairing support as its empirical context. Valid questionnaires were collected from 52 local teachers at beneficiary high-schools in Yunnan Province and 40 supporting teachers dispatched from Shanghai. Individual-level questionnaire answers were aggregated to construct 11 school-level case units for analysis. After constructing a performance assessment indicator framework, this paper carries out configurational empirical tests via fuzzy-set Qualitative Comparative Analysis (fsQCA). Findings show that no single condition can independently bring about high-quality assistance performance. Long-run institutional arrangements and two-way Shanghai-Yunnan teaching-research cooperation function as core foundations for desirable support effects. Four alternative pathways may generate high-quality outcomes, namely comprehensive coordination-balanced mode, resource-collaboration-oriented mode, policy-teacher adaptive mode, and long-term-institution-guaranteed mode. Beneficiary schools with varied internal resource endowments can achieve satisfactory support results through different factor combinations. Accordingly, authorities should consolidate institutional safeguards, strengthen two-sided teaching-research links, and deliver classified support according to actual school-level conditions. This work offers empirical references for improving cross-provincial educational pairing practices between eastern and western China.

Keywords: East-West Collaboration; Group-Based Educational Assistance; Performance Evaluation; fuzzy-set Qualitative Comparative Analysis (fsQCA); Configurational Effect

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1. Introduction: Research Background and Research Questions

1.1. Research Background

For decades, China has rolled out different forms of educational support for economically backward regions. Practices have shifted from short-term volunteer teaching and one-on-one school-to-school pairing toward systematic east-west collaborative mechanisms in the new era. One practical puzzle remains observable: given comparable financial and human resource inputs for external assistance, why do some recipient schools greatly improve their operational capacity while others only obtain fragile, non-sustainable progress?

This practical question carries strong policy relevance after the country eliminated absolute poverty in 2020. Hardware investment, fiscal funds and short-term dispatched teachers alone cannot resolve deep-seated educational gaps related to teacher capacity, school governance and campus cultural ecosystems. While consolidating poverty-alleviation gains, educational assistance priorities have gradually moved beyond

hardware-focused "blood transfusion" toward capacity-building for local teaching staff and internal school governance systems. A national policy released jointly by eight ministries and commissions in 2022 on group-mode educational talent assistance for key rural-revitalization counties marks this policy transformation.

Group-based educational assistance refers to three-year resident support practice, where eastern partner regions send complete teams including principals, administrative staff and core subject teachers to work at under-resourced western schools. By transplanting management rules, demonstrating classroom instruction and rebuilding school-based culture, this model helps recipient schools shift from externally-driven support toward endogenous capacity growth. The model originated from pilot assistance work conducted by Jiangsu and Beijing in 2014; relevant experiences were later tested in locations such as Taijiang County of Guizhou Province before being scaled into nationwide policy. Within Shanghai-Yunnan cooperation arrangements, Shanghai has implemented group-team educational support covering 38 Yunnan senior high-schools. Complete educational teams participate in the full-range daily operations of county-level high-schools in Yunnan.

Field investigations show large performance gaps among assisted schools. Some institutions witness notable quality improvement after receiving personnel and resource input, whereas other schools cannot translate outside resources into lasting operational capacity even under similar assistance inputs. Conventional performance evaluation builds indicator systems for weighted comparison, which facilitates horizontal ranking among schools but cannot answer which condition combinations yield better support results. Cross-regional educational pairing represents multi-agent governance activity, whose outcomes seldom depend on isolated influencing factors. It is therefore necessary to adopt configurational analytical thinking instead of linear causal assumptions to unpack how high-performance assistance comes into being. Against such background, this paper applies fsQCA to identify alternative pathways for generating satisfying group-based assistance outcomes under Shanghai-Yunnan cooperation.

1.2. Research Questions

1. Are there indispensable single preconditions for high-quality performance of Shanghai-Yunnan group-based educational assistance?
2. What equifinal configurational combinations can produce desirable group-assistance performance, and how can we tell core conditions from peripheral auxiliary conditions within those configurations?

2. Literature Review and Research Gaps

2.1. Review of Relevant Studies

Overseas researchers have long adopted configurational logic and fsQCA for public education policy assessment. Ragin's configurational causal paradigm breaks the net-effect assumptions dominating traditional regression analysis, offering methodological support for studying multi-factor interactive phenomena in educational governance [1]. Fiss further improved configurational research frameworks for organization and public-policy domains, expanding fsQCA's applicability for small-, medium- and large-N case samples [2]. Dul et al. put forward statistical testing procedures for necessity analysis and optimized condition-judging standards for configurational studies, supplying rigorous technical references for related empirical work [3]. Multiple foreign papers employ fsQCA to examine implementation effects of cross-regional educational aid and collaborative policies. Such literature highlights equifinal effects produced by multi-party coordination and supply-demand fit, sorting out differentiated pathways for realizing policy objectives under varied institutional contexts. Nevertheless, most overseas empirical evidence targets educational governance projects in developed economies. Configurational empirical research focusing on large-scale inter-provincial educational pairing within developing countries remains limited. Though these studies provide methodological references, they cannot fully explain local institutional logics and practical traits of China's

group-mode educational assistance. Domestic scholars have accumulated rich findings on educational pairing and group-based assistance. Several papers evaluate group-support practices through policy document analysis and field interviews, sorting out practical bottlenecks including institutional embedding, teacher mentoring and supply-demand matching, and summarizing local operational experience. Other research constructs assistance evaluation frameworks following input-process-output dimensions. Still, much domestic work follows linear analytical logics, putting emphasis on net-effect estimation for individual variables while paying insufficient attention to interactive configurational effects brought by multiple factors [4]. While several Chinese papers have applied fsQCA to rural educational support, educational equity and teacher development, few empirical studies adopt first-hand survey questionnaires to conduct configurational attribution for cross-provincial Shanghai-Yunnan group-based assistance at senior high-school level [5].

Synthesizing existing literature, three major research gaps are identified. First, most empirical studies adopt linear paradigms and overlook concurrency causality as well as synergy and substitution effects among multiple factors within assistance practices. Second, performance evaluation research frequently stops at performance scoring and ranking, lacking configurational attribution analysis for the formation of performance outcomes. Third, studies focusing on Shanghai-Yunnan group-based educational assistance are dominated by qualitative experiential summaries; empirical configurational tests based on original questionnaire surveys remain limited. This paper constructs an assistance-performance analytical framework and uses fsQCA to explore equifinal pathways toward desirable assistance outcomes, so as to fill above-mentioned research gaps.

2.2. Literature Comments and Research Gaps

Consistent with above-mentioned review results, existing scholarship presents three major shortcomings. First, most empirical studies stick to linear analytical paradigms and insufficiently discuss factor complementarity, substitution and concurrent causality. Second, performance evaluation research tends to focus on scoring and ranking without exploring configurational sources behind performance differences. Third, studies targeting Shanghai-Yunnan group-based assistance are largely qualitative summaries, and configurational empirical evidence based on original questionnaire data is quite limited. This paper establishes an analytical framework for assistance performance and leverages fsQCA to identify multiple equifinal pathways for high-quality assistance outcomes, responding to these research deficiencies.

3. Theoretical Foundations

3.1. Collaborative Governance Theory

Collaborative governance theory highlights that multiple governance actors break institutional barriers and pursue public governance goals via interactive negotiation. Yang et al described its operational mechanism as nested structure featuring "party-government support plus internal school-governance reform [6]." Shanghai-Yunnan group-based educational assistance involves many stakeholders: sending-side schools in Shanghai, dispatched teacher teams, local educational administrative departments of Yunnan, and recipient schools. Final assistance outputs are never determined by one single participant. Resource allocation, teaching-research activities and policy implementation all depend on multi-agent interactive cooperation. Collaborative governance theory provides theoretical support for interpreting multi-party relationships within group-assistance scenarios.

3.2. Supply-Demand Matching Theory

Supply-demand matching theory emphasizes alignment between services delivered by supply-side actors and real-world demands from demand-side recipients. Xie argued that traditional assistance models are constrained by "blood-transfusion-style" resource delivery [7]. Regardless of the volume of capital, facilities or teachers invested, genuine

improvements in educational quality cannot be achieved without transforming internal school management and teaching culture [7, pp. 107–108]. Under Shanghai-Yunnan assistance practices, supply-side actors send teachers, teaching-research resources and management experience. In the meantime, beneficiary schools face practical constraints such as subject-specific teacher shortages, insufficient teaching-research capacity and defective management models. Mismatch between assistance supply and local school-running needs prevents external resource inputs from translating into tangible educational progress. Supply-demand matching theory guides variable selection within this research.

3.3. Configurational Causation Theory

Configurational causation differs from the linear net-effect hypothesis widely adopted in conventional regression analysis. It holds that social-science outcome variables are jointly shaped by combined multiple conditions. Identical outcome may be realized through diverse condition combinations, which is known as equifinality. Whether a certain condition generates positive influence depends on its contextual combination with other factors. Within Shanghai-Yunnan educational assistance contexts, high-quality outcomes do not come from isolated single factors. Satisfactory performance can be achieved under different condition portfolios. Such logic constitutes the theoretical basis for adopting fsQCA in this paper.

4. Policy Evolution and Implementation Characteristics of Shanghai-Yunnan Group-Based Educational Pairing Assistance

4.1. Policy Development of Shanghai-Yunnan Group-Based Assistance

Shanghai-Yunnan educational pairing assistance has undergone multi-stage evolution. Early practices featured decentralized short-term volunteer teaching relying on individual teachers, whose impacts were largely confined to classroom instruction. Later, assistance entered a centralized phase with expanded input of material and human resources, yet it remained dominated by one-way resource delivery.

Under national deployment for east-west collaboration and group-based talent assistance in education, Shanghai-Yunnan collaboration has evolved toward group-embedded support. Complete assistance teams consisting of administrative cadres and multi-subject key teachers are deployed to deeply participate in teaching, research and internal governance of recipient schools. Assistance priorities have shifted from short-term substitute teaching to systematic capacity building for recipient schools.

At the organizational level, Shanghai has established a three-tier promotion system of "municipal-level overall planning, district-level implementation and inter-school collaboration". Authority over personnel deployment, fund allocation and performance incentives is integrated within a unified decision-making platform to avoid inter-departmental friction. In recipient regions of Yunnan, team leaders serve as associate principals of recipient schools, combining school managerial authority with county-level resource-coordination capacity to connect internal school administration and county-level educational resource allocation. Incentive measures such as green channels for professional-title evaluation for dispatched teachers are implemented to stabilize team members. The institutional logic of title-evaluation incentives analysed by Yang et al for educational assistance offers references for Shanghai-Yunnan practices, although differences in sending agents and local preconditions prevent direct analogy. A bidirectional matching approach of "demand lists plus capacity mapping" is adopted in implementation. Recipient schools in Yunnan submit demand applications, based on which Shanghai selects qualified candidates and assembles teams composed of "one principal plus several middle-level administrators and subject-specific backbone teachers". This model pursues compatibility in subject structure, managerial experience and cultural guidance. As described by Xie, assistance stakeholders have expanded "from single subjects to multiple subjects and then to full participation [7, p. 109]." Rather than assigning outstanding teachers merely for substitute teaching, complementary teams are

assembled for holistic school operation, so as to align assistance supply with local practical school-running demands.

4.2. Core Measures and Practical Characteristics of Assistance Implementation

Five core practical measures characterize Shanghai-Yunnan group-based assistance. First, management embedding: assistance team members participate in daily administration covering teaching, moral education and teaching-research activities to standardize institutional construction within recipient schools. Second, establishment of joint Shanghai-Yunnan teaching-research mechanisms: peer classroom observation and hybrid joint teaching-research activities reshape school-based research routines among local teachers. Third, construction of local teacher development systems: closed-loop training covering universal training, on-site attachment learning and post-attachment practice facilitates professional advancement of local teachers. Fourth, promotion of cross-regional educational-cultural exchange: dispatched teachers bring professional concepts and exemplary teaching behaviours to recipient schools, complemented by student study-tour programmes delivering implicit educational support. Fifth, spill-over extension of assistance experience at county level: under the "1+3" model, core recipient schools drive improvements in three neighbouring weak schools to magnify assistance spill-over effects.

In practice, Shanghai-Yunnan group-based educational assistance represents complex multi-factor-intervening activity. Final assistance performance is constrained by multiple factors including supply-demand fit quality, two-sided teacher-collaboration quality, dispatched-teacher adaptation, local policy execution, resource supply and completeness of long-run institutional arrangements. Since recipient schools possess heterogeneous resource endowments, high-quality assistance outcomes can be realized through different factor portfolios, reflecting typical equifinal practical features.

5. Construction of Performance Evaluation Indicators and FsQCA Configurational Empirical Analysis

5.1. Construction Principles and Dimensional Framework of the Evaluation Indicator System

This analytical framework originates from practical concerns over measuring real performance generated by Shanghai-Yunnan group-based assistance. Drawing on group-assistance practical traits, existing literature foundation and questionnaire-design requirements, this research establishes an analytical framework covering six dimensions: supply-demand matching, bilateral collaboration, dispatched-agent adaptation, policy implementation, resource provision and institutional mechanisms. These six dimensions are further operationalized into one outcome variable (comprehensive high-quality assistance performance) together with seven antecedent conditional variables. The corresponding evaluation indicator system is shown in Table 1. Questionnaire items correspond to each dimension, and raw variable scores are obtained through item aggregation. The indicator system supports questionnaire design as well as variable selection for fsQCA analysis. The outcome variable measures comprehensive high-quality assistance performance. Antecedent conditions include supply-demand matching degree, Shanghai-Yunnan collaboration smoothness, adaptation level of Shanghai-dispatched teachers, policy-implementation effect, low policy-implementation resistance, provision of digital teaching-research resources, and completeness of long-term assistance mechanisms.

Table 1. Performance Evaluation Indicator System

Variable Category	Variable Name	Variable Code	Sources of Survey Items	Synthesis Method	Variable Property
Outcome Variable Y	Comprehensive high-quality assistance performance	Y	Items 3,4,6 from local-teacher questionnaire; assistance-satisfaction and school-change	Dual-agent weighted synthesis; weight for local	Positive

		composite scores from dispatched-teacher questionnaire		teachers = 0.6, weight for dispatched teachers = 0.4; values range 1-5; higher scores indicate better assistance performance Arithmetic mean of scores within each school; values 1-5	Positive
Antecedent Condition					
C1	Supply-demand matching degree	C1	Scale item 4 in local- teacher questionnaire	Arithmetic mean within each school; values 1-5	
C2	Smoothness of Shanghai-Yunnan collaboration	C2	Matrix scale item 6 in local-teacher questionnaire	Arithmetic mean within each school; Positive values 1-5	
C3	Adaptation of dispatched teachers	C3	Relevant scale items in dispatched-teacher questionnaire	Arithmetic mean within each school; Positive values 1-5	
C4	Policy- implementation effect	C4	Matrix scale item 8 in local-teacher questionnaire	Arithmetic mean within each school; Positive values 1-5	
C5	Low policy- implementation resistance	C5	Policy-resistance evaluation items from dispatched-teacher questionnaire	Reverse scoring for original resistance items; higher scores denote lower resistance	Positive (reverse- coded)
C6	Provision of digital teaching-research resources	C6	Quantified multiple- choice item 2 in local- teacher questionnaire	Arithmetic mean within each school; Positive values 1-5	
C7	Completeness of long-term assistance mechanisms	C7	Reverse quantification of gap-related item 9 in local-teacher questionnaire	Arithmetic mean within each school; Positive values 1-5	

Note: This indicator system serves variable operationalization for fsQCA empirical analysis targeting performance and its antecedent conditions. It is not developed as an administrative assessment tool and cannot be directly applied for quantitative scoring or ranking of recipient schools.

5.2. Data Sources, Sample Statistics and Questionnaire Reliability-Validity Tests

Two stratified questionnaire surveys collect primary empirical data. One questionnaire targets local teachers at Yunnan beneficiary senior high-schools: 60 copies distributed and 52 valid responses obtained, reaching 86.67 % valid response rate. The second questionnaire is for Shanghai-dispatched group-assistance teachers: 46 copies distributed and 40 valid responses collected, valid response rate 86.96 %. Survey samples cover senior high-schools distributed across western, northeastern and southeastern Yunnan. Although questionnaires are answered by individual teachers, fsQCA analysis takes recipient senior high-schools as analytical units. Item scores of teachers belonging to one same school are averaged to produce observation values for each case school. Cases with insufficient questionnaire quantity or missing information are eliminated, finally

obtaining 11 valid school-level cases for fsQCA computation. Student-survey materials are only used as auxiliary contextual reference and are not incorporated into model estimation. Reliability testing shows Cronbach's α coefficients exceed 0.8 for both questionnaires, demonstrating acceptable reliability. Item factor loadings for each dimension meet construct-validity standards. The dual-agent questionnaire design partly mitigates common-method bias brought by teachers' subjective self-reports, yet such potential bias cannot be completely ruled out. This limitation will be further discussed within the research-limitation section.

5.3. Variable Selection and Indicator Synthesis for FsQCA

Outcome Variable Y: Comprehensive high-quality assistance performance

Composite continuous outcome variable is generated through dual-agent weighted aggregation: evaluation weight for local teachers equals 0.6 and weight for Shanghai-dispatched teachers equals 0.4. Value ranges between 1–5; higher scores stand for better comprehensive assistance performance. Local-teacher component (N=52): averaged scores of assistance-improvement matrix items, supply-demand-matching item, and Shanghai-Yunnan-collaboration item. Dispatched-teacher component (N=40): averaged assistance-satisfaction matrix scores and composite ratings of recipient-school developmental changes.

Seven antecedent conditional variables

Table 2 presents the definitions and sample statistics of all variables. The seven antecedent conditions include supply-demand matching degree, Shanghai-Yunnan collaboration smoothness, adaptation level of Shanghai-dispatched teachers, policy-implementation effect, low policy-implementation resistance, provision of digital teaching-research resources, and completeness of long-term assistance mechanisms.

Table 2. Variable Definitions and Sample Statistics

Variable codes	Code	Variable Name	Questionnaire Sources and Sample Statistics
<i>fc1</i>	C1	Supply-demand matching degree	Item 4 (local teachers, N = 52, overall mean = 4.02)
<i>fc2</i>	C2	Smoothness of Shanghai-Yunnan collaboration	Matrix item 6 (local teachers, N = 52, overall mean = 3.98)
<i>fc3</i>	C3	Adaptation of dispatched teachers	Dispatched-teacher questionnaire (N = 40, overall mean = 3.79)
<i>fc4</i>	C4	Policy-implementation effect	Matrix item 8 (local teachers, N = 52, overall mean = 3.91)
<i>fc5</i>	C5	Low policy-implementation resistance	Reverse-coded policy-resistance scores from dispatched-teacher questionnaires (N = 40, mean = 2.35)
<i>fc6</i>	C6	Provision of digital teaching-research resources	Quantified multiple-choice item 2 from local-teacher surveys; 63.46 % of respondents rank digital resources as the top priority demand (N = 52)
<i>fc7</i>	C7	Completeness of long-term assistance mechanisms	Reverse quantification of gap-item 9 from local-teacher surveys; 65.38 % of respondents report deficiencies in long-term institutional arrangements (N = 52)

5.4. FsQCA Methodology and Mathematical Basis

All configurational calculations are performed using fsQCA 3.0 software. Fuzzy-set Qualitative Comparative Analysis integrates strengths of qualitative case studies and quantitative statistics. Case-specific condition information is transformed into fuzzy

membership scores within the interval [0, 1]. Configurational computation is implemented based on Boolean algebra logic to identify multiple equifinal paths behind phenomena and distinguish core from peripheral conditions.

5.4.1. Basic Boolean Operations for Fuzzy-set Analysis

For any case x , the fuzzy-set membership of condition set A is denoted. Three core operations underpin configurational analysis:

Negation (condition absence)

$$\mu_{\neg A}(x) = 1 - \mu_A(x)$$

Logical AND (co-existence of multiple conditions, configurational intersection)

$$\mu_{A \cdot B}(x) = \min[\mu_A(x), \mu_B(x)]$$

Logical OR (substitutable conditions, union of equifinal paths)

$$\mu_{A+B}(x) = \max[\mu_A(x), \mu_B(x)]$$

5.4.2. Direct Fuzzy-set Calibration Formula

Following Ragin's direct-calibration approach, raw 1-5 Likert-scale scores are non-linearly mapped onto the [0, 1] membership interval:

$$\mu(X) = \frac{1}{1 + \exp\left[-k \frac{X-c}{f-n}\right]}$$

In the formula, $k = 1$ (software-default curvature); f = full-membership threshold; c = crossover point; n = full-non-membership threshold. For positive variables, thresholds are uniformly set as $n = 1.5$, $c = 3.0$, $f = 4.5$. Thresholds are reversed for the reverse-coded indicator C5.

5.4.3. Indicators for Single-condition Necessity Tests

For necessity consistency, consistency ≥ 0.9 is widely adopted as the critical threshold for identifying a necessary condition.

$$\text{Consistency}(X \Rightarrow Y) = \frac{\sum \min[\mu_X, \mu_Y]}{\sum \mu_Y}$$

Necessity unique coverage reflects the explanatory power of a given condition.

$$\text{Coverage}(X \Rightarrow Y) = \frac{\sum \min[\mu_X, \mu_Y]}{\sum \mu_X}$$

5.4.4. Sufficiency Criteria for Truth-table Analysis

Configurational sufficiency consistency: a threshold of ≥ 0.75 is commonly adopted in social-science empirical research.

$$\text{Consistency}(X \Rightarrow Y) = \frac{\sum \min(\mu_X, \mu_Y)}{\sum \mu_X}$$

PRI (Proportional Reduction in Inconsistency): filters contradictory configurations; threshold ≥ 0.7 .

$$PRI = \frac{(\sum \min(\mu_X, \mu_Y) - \sum \min(\mu_X, 1 - \mu_Y))}{\sum \min(\mu_X, \mu_Y)}$$

Solution overall coverage reflects the model's overall explanatory power.

$$\text{Solution Coverage} = \frac{\sum \min(\mu_{X_{\text{all}}}, \mu_Y)}{\sum \mu_Y}$$

This study focuses exclusively on driving configurations for the presence of high-quality assistance performance and does not analyse configurations for the negation of the outcome. Intermediate solutions incorporate only theoretically plausible logical remainders and exclude counter-intuitive logical remainders.

5.5. Data Preprocessing and Fuzzy-Set Calibration

Questionnaire responses from 52 local teachers and 40 dispatched teachers are matched by school identifiers. Invalid samples are removed to obtain a standardized case dataset. All variables are calibrated using the direct-calibration formula to generate fuzzy-membership variables. Cases with membership exactly equal to 0.5 are excluded to avoid analytical bias at set boundaries. Table 3 summarizes the calibration thresholds for fuzzy-set variables.

Table 3. Calibration Thresholds for Fuzzy-Set Variables

Variable Type	Variable codes	Variable Name	Full non-Crossover members hip (n)	Cr point (c)	Full members hip (f)	Variable Property
Outcome Variable	<i>fy</i>	High-quality assistance performance	1.5	3.0	4.5	Positive indicator
	<i>fc1</i>	Supply-demand matching degree	1.5	3.0	4.5	Positive indicator
	<i>fc2</i>	Smoothness of Shanghai-Yunnan collaboration	1.5	3.0	4.5	Positive indicator
	<i>fc3</i>	Adaptation of dispatched teachers	1.5	3.0	4.5	Positive indicator
	<i>fc4</i>	Policy-implementation effect	1.5	3.0	4.5	Positive indicator
	<i>fc5</i>	Low policy-implementation resistance	4.5	3.0	1.5	Reverse-coded positive indicator
	<i>fc6</i>	Provision of digital teaching-research resources	1.5	3.0	4.5	Positive indicator
Antecedent Condition	<i>fc7</i>	Completeness of long-term assistance mechanisms	1.5	3.0	4.5	Positive indicator

5.6. Single-Condition Necessity Analysis

Necessity of both the presence and the absence of each antecedent condition for high-quality assistance performance is tested using necessity-consistency and unique-coverage formulas. Following Dul et al., consistency ≥ 0.9 serves as the critical cut-off for identifying necessary conditions. Results are presented in Table 4.

Table 4. Necessity Analysis of Antecedent Conditions for High-Quality Assistance Performance

Condition codes	Condition	Consistency	Unique Coverage	Judgement
<i>fc1</i>	Supply-demand matching	0.785	0.816	Not a necessary condition
$\sim fc1$	Supply-demand matching	0.312	0.273	Not a necessary condition
<i>fc2</i>	Smooth Shanghai-Yunnan collaboration	0.844	0.870	Not a necessary condition
$\sim fc2$	Smooth Shanghai-Yunnan collaboration	0.206	0.180	Not a necessary condition
<i>fc3</i>	Dispatched-teacher adaptation	0.753	0.787	Not a necessary condition
<i>fc4</i>	Effective policy implementation	0.806	0.838	Not a necessary condition
<i>fc5</i>	Low implementation resistance	0.721	0.758	Not a necessary condition
<i>fc6</i>	Sufficient digital resources	0.829	0.854	Not a necessary condition
<i>fc7</i>	Complete long-term assistance mechanisms	0.878	0.895	High consistency, close to a necessary condition
$\sim fc7$	Complete long-term assistance mechanisms	0.191	0.163	Not a necessary condition

No single antecedent condition achieves the 0.9 consistency threshold for a necessary condition. This finding demonstrates that high-quality assistance outcomes require configurational synergy of multiple conditions. The completeness of long-term assistance mechanisms obtains the highest consistency value of 0.878, consistent with survey evidence that 65.38 % of local teachers identify insufficient long-term mechanisms as a major practical shortcoming. The low consistency value (0.191) for the absence of long-

term mechanisms indicates that sustainable high-quality assistance is difficult to achieve without long-term institutional support.

5.7. Truth-Table Construction and Configuration Selection

Given the medium-sample setting of 11 school cases, truth-table parameters are set as follows: case frequency threshold = 2, consistency threshold = 0.75, PRI threshold = 0.7. To avoid over-fitting driven by single-case configurations in medium-sample fsQCA, only configurations supported by at least two cases are retained. All antecedent conditions are theoretically expected to exert positive effects on assistance performance. For logical remainders, intermediate-solution computation incorporates only remainders consistent with collaborative-governance and supply-demand-matching theoretical expectations and excludes counter-intuitive remainders. High-consistency configurations filtered from the truth table are excerpted in Table 5.

Table 5. Excerpt of High-Consistency Configurations from the Truth Table (Consistency ≥ 0.75)

Config. No.	fc1	fc2	fc3	fc4	fc5	fc6	fc7	Case Frequency	Consistency	Outcome fy
1	1	1	1	1	1	1	1	2	0.944	1
2	1	1	0	1	1	1	1	2	0.888	1
3	1	1	1	0	1	0	1	2	0.843	1
4	0	1	1	1	0	1	1	2	0.795	1

Note: C1-C7 denote supply-demand matching, Shanghai-Yunnan collaboration smoothness, dispatched-teacher adaptation, policy-implementation effect, low policy-implementation resistance, provision of digital teaching-research resources, completeness of long-term assistance mechanisms respectively. "1" = high membership of the condition; "0" = low membership. Outcome=1 indicates that the configuration yields high-quality assistance performance. Outputs generated by fsQCA 3.0; only configurations with consistency ≥ 0.75 are excerpted.

5.8. Interpretation of Multiple Equifinal Configurations for High-Performance Assistance

FsQCA generates three types of solutions: complex, parsimonious and intermediate solutions. This paper reports intermediate solutions as primary empirical results. Core versus peripheral conditions are distinguished by comparing intermediate and parsimonious solutions. The overall solution consistency reaches 0.869 and overall coverage 0.727. The four configurations explain 72.7 % of schools achieving high-quality assistance performance. Table 6 presents the configurations generating high-quality Shanghai-Yunnan group-based educational assistance outcomes (intermediate solution).

Table 6. Configurations Generating High-Quality Shanghai-Yunnan Group-Based Educational Assistance Outcomes (Intermediate Solution)

Conditions	Config.1 Comprehensive Coordination-Balance Mode	Config.2 Resource-Collaboration -Dominated Mode	Config.3 Policy-Teacher- Adaptation Mode	Config.4 Long-Term-Mechanism - Backstopping Mode
fc1 Supply-demand matching	●	●	●	○
fc2 Smooth Shanghai-Yunnan collaboration	●	●	○	●
fc3 Dispatched-teacher adaptation	●	○	●	●
fc4 Policy-implementation effect	●	●	●	○
fc5 Low implementation resistance	●	●	○	●
fc6 Digital teaching-research resources	●	●	○	●

<i>fc7</i> Complete long-term assistance mechanisms	●	●	●	●
Configuration consistency	0.944	0.888	0.843	0.795
Unique coverage	0.165	0.138	0.110	0.093
Overall solution consistency	0.869			
Overall solution coverage	0.727			

Legend: = condition present; = condition absent; blank = condition may be either present or absent without decisive constraint.

5.8.1. Configuration 1: Comprehensive Coordination-Balance Mode (Consistency = 0.944)

All seven conditions achieve high membership. Corresponding recipient schools realize precise matching of assistance demands, regular joint teaching-research activities, sufficient local adaptation of dispatched teachers, smooth policy implementation, low implementation resistance, adequate digital teaching-research resources and complete long-term assistance institutions. Among schools with high membership in this configuration, satisfaction with hardware improvement reaches 100%, and 78.85 % of local teachers report marked progress in teaching quality. This path yields optimal assistance performance yet imposes high requirements for multi-dimensional synergy among capital, human resources and institutions. It is suitable for constructing regional demonstration schools.

5.8.2. Configuration 2: Resource-Collaboration-Dominated Mode (Consistency=0.888)

While dispatched-teacher adaptation is insufficient, simultaneous advantages in supply-demand matching, bilateral teaching-research collaboration, low implementation resistance, sufficient digital resources and complete long-term mechanisms still produce high-quality assistance outcomes. In total, 63.46% of local teachers identify digital teaching-research resources as their most urgent assistance demand. Standardized online teaching-research materials can partly offset deficiencies in short-term local adaptation of rotated dispatched teachers. This configuration fits county-level senior high schools with sound hardware foundations and annual rotation of dispatched teachers.

5.8.3. Configuration 3: Policy-Teacher-Adaptation Mode (Consistency=0.843)

Insufficient digital-resource provision and relatively high policy-implementation resistance co-occur. Nevertheless, complementary combinations of precise supply-demand matching, stable teaching-research communication, good adaptation of dispatched teachers, effective local policy implementation and long-term assistance mechanisms compensate for hardware shortcomings. As 40.38% of local teachers report mismatches between assigned subjects and actual subject-specific shortages within schools, precise deployment of teachers for scarce science subjects and improved local incentive policies can mitigate disadvantages stemming from insufficient digital resources and laboratory facilities. This path applies to remote county-level senior high schools with limited fiscal capacity.

5.8.4. Configuration 4: Long-Term-Mechanism-Backstopping Mode (Consistency = 0.795)

Deficiencies in supply-demand matching and local policy implementation exist. Nevertheless, well-established long-term tracking institutions, sustained bilateral teaching-research collaboration, stable resource provision and good dispatched-teacher adaptation still deliver above-average assistance performance. As 65.38% of survey respondents identify short assistance cycles and insufficient long-term follow-up as prominent practical pain points, long-term institutions such as sustained teacher-mentoring relationships and regular online teaching-research can gradually mitigate supply-demand misalignment over time. This serves as a fallback improvement path for schools with weak pre-existing foundations.

5.9. Identification of Core Conditions and Mechanism Interpretation

Following standard fsQCA practice, conditions appearing in both parsimonious and intermediate solutions are defined as core conditions with strong causal relevance. Conditions appearing only in intermediate but not parsimonious solutions are defined as peripheral auxiliary conditions. Core-condition identification results are summarized in Table 7.

Table 7. Summary of Core-Condition Identification from Parsimonious Solutions

Variable	Condition	Attribute	Survey-Based Interpretation
<i>fc7</i>	Completeness of long-term assistance mechanisms	Core condition	Required across all four configurations. 65.38 % of local-teacher respondents report risks of short-term-oriented assistance without sustained tracking; it constitutes a fundamental underpinning for high-quality outcomes.
<i>fc2</i>	Smoothness of Shanghai-Yunnan collaboration	Core condition	Stably present in three configurations. 71.15 % of local teachers cite divergent teaching philosophies and work rhythms as major sources of friction; regular teaching-research communication substantially alleviates such conflicts.
<i>fc1</i> , <i>fc4</i> , <i>fc6</i>	Supply-demand matching, policy-implementation effect, digital teaching-research resources	Peripheral conditions	Subject to substitution and complementarity via other conditions; non-indispensable.
<i>fc3</i> , <i>fc5</i>	Dispatched-teacher adaptation, low policy-implementation resistance	Peripheral conditions	Exhibit mutual complementarity; deficiency in one may be offset by advantages in the other, without constituting hard constraints.

Long-term assistance mechanisms and bilateral Shanghai-Yunnan teaching-research collaboration constitute the two core conditions recurring across equifinal configurations. Supply-demand matching, policy implementation, digital-resource provision, dispatched-teacher adaptation and policy-implementation resistance are peripheral conditions featuring evident complementarity and substitutability. Even with shortcomings in resources, personnel or policies, relatively satisfactory assistance performance can still be achieved as long as the two core conditions of bilateral collaboration and long-term mechanisms are maintained.

5.10. Robustness Tests

Three mainstream approaches are adopted to reduce result bias brought by artificial calibration-threshold and consistency-threshold settings. First, truth-table consistency threshold is raised from 0.75 to 0.80 and 0.85 for repeated re-estimation. Second, full-membership and full-non-membership thresholds are adjusted by ± 0.2 for recalibration. Third, each antecedent condition gets sequentially removed for repeated model-building. After multiple rounds of re-estimation, overall-solution consistency fluctuates between 0.852-0.871; overall-coverage index fluctuates between 0.703-0.741. Four configurational pathways keep substantive content unchanged, and core-peripheral condition classification remains stable. Above-mentioned checks verify empirical result robustness.

5.11. Empirical Summary

Three mainstream approaches are adopted to reduce result bias brought by artificial calibration-threshold and consistency-threshold settings. First, truth-table consistency threshold is raised from 0.75 to 0.80 and 0.85 for repeated re-estimation. Second, full-membership and full-non-membership thresholds are adjusted by ± 0.2 for recalibration. Third, each antecedent condition gets sequentially removed for repeated model-building.

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6. Conclusions and Optimizing Countermeasures

6.1. Main Conclusions

First, no single necessary driving condition exists for high-quality outcomes of Shanghai-Yunnan group-based educational assistance. Merely expanding teacher teams, increasing resource input or improving local policies cannot automatically generate high-quality assistance results. Configurational synergy among multiple conditions is required to achieve desirable performance.

Second, long-term assistance mechanisms and bilateral Shanghai-Yunnan teacher collaboration represent two core foundational conditions shared by all high-performance configurations. Supply-demand matching, local adaptation of dispatched teachers, policy implementation and digital-resource provision are peripheral conditions characterized by prominent complementarity and substitutability.

Third, four multiple equifinal paths produce high-quality assistance outcomes: comprehensive coordination-balance mode, resource-collaboration-dominated mode, policy-teacher-adaptation mode, and long-term-mechanism-backstopping mode. Recipient schools with diverse school-running foundations and fiscal endowments can realize high assistance performance through different factor combinations. "One-size-fits-all" thinking should be discarded in assistance practice.

6.2. Targeted Assistance Optimization Countermeasures Derived from Configurational Paths

First, consolidate the two core conditions and strengthen institutional foundations for assistance. Improve multi-year long-term follow-up assistance mechanisms to mitigate loss of assistance achievements caused by personnel rotation. Establish sustained teacher-mentoring inheritance and regular online teaching-research follow-up to counter the "person-departure effect". Meanwhile, reinforce bilateral Shanghai-Yunnan teacher collaboration and build regular joint teaching-research platforms to alleviate frictions stemming from divergent teaching philosophies and work rhythms.

Second, implement classified support policies corresponding to different configurational pathways. Demonstration-type senior high-schools possessing comprehensive original advantages can adopt comprehensive coordination-balance mode, simultaneously equipping teaching-research resources, scarce-subject teachers, local supporting policies and long-run institutional arrangements. For county-level schools with sound hardware but facing frequent dispatched-teacher rotation, priority should be given to deploying digital teaching-research resources; standardized teaching-research materials can compensate short-term adaptation deficiencies among rotated teachers. For remote schools under fiscal constraints, priority should be given to precise deployment of scarce-subject teachers, leveraging teacher strengths to offset hardware disadvantages. For recipient schools with weak foundational conditions, priority should be placed on constructing long-term assistance mechanisms; supply-demand matching can be gradually optimized under sustained bilateral collaboration.

Third, improve assistance supply and raise supply-demand matching precision. Carry out thorough pre-implementation field investigation on school-level practical demands; build dynamically-updated school-running-demand lists. Match dispatched subject-specific teachers and teaching-research resources against real-world local educational shortages, so as to reduce mismatch between assistance supply and local practical needs.

Fourth, upgrade performance-evaluation thinking and introduce configurational-attribution perspectives. Beyond traditional scoring-oriented performance assessment, evaluators should pay attention to configurational logics behind performance differences. Evaluations should not merely focus on final scores, but unpack internal performance-

generation logics, providing more comprehensive decision-making references for improving cross-regional east-west educational-pairing practices.

6.3. Limitations and Future Research Directions

This study has several noticeable limitations. First, questionnaire samples only cover senior high-schools inside Yunnan Province; research conclusions cannot be directly generalized toward compulsory-education or vocational-education scenarios. Second, empirical data entirely rely on teachers' subjective questionnaire self-reports. Although dual-agent questionnaire design mitigates common-method bias, objective indicator cross-validation is absent, and such bias cannot be fully eliminated. Third, cross-sectional questionnaire data capture configurational characteristics within one single time snapshot and cannot track dynamic evolution of assistance configurations across time. Fourth, individual-level questionnaire responses are aggregated to school-level case units, which brings partial loss of individual-level heterogeneity; objective panel-type data such as local fiscal-investment statistics are not incorporated. Future research may expand sample coverage, adopt multi-wave follow-up questionnaires, combine objective school-running indicators and multi-stakeholder evaluation materials, to further explore dynamic evolution rules for configurational relationships within group-based educational assistance.

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