Research On Cost-Benefit Analysis And Path Optimization Of Attracting And Retaining Talents In County-level Vocational Education

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Abstract

This study focuses on the cost-benefit imbalance of attracting and retaining talents in county vocational education, and reveals the key bottlenecks and optimization paths in the development of county vocational education by constructing the analytical framework of "cost-input-benefit-output-optimization-path", and by combining empirical analyses with cases of typical counties in the eastern, central and western regions. It is found that the marginal benefit of inputs for the integration of production and education (e.g., the construction of training bases by schools and enterprises) is the highest for county GDP (every 10,000 yuan of inputs in county A in the eastern part of the country drives the growth of 0.14 million yuan), while the hidden cost in less developed areas accounts for more than 60% of the total (e.g., the average annual replacement cost of county C in the western part of the country is 1.8 times of the visible cost due to the loss of talents). Generational differences in needs significantly affect the incentive effect, and the new generation of teachers is more sensitive to non-economic incentives (flexible working system, career development path) than traditional salaries. Based on this, we put forward the optimization strategy of "differentiated inputs, precise incentives, and dynamic adaptation", suggesting that the government should give priority to guaranteeing financial inputs in the field of high efficiency and benefit, and that institutions should implement the multi-dimensional

incentives of "broadband salary+ and double-line promotion", and strengthen the policy through the synergy of legislation and digital monitoring, in order to solve the problem of VET in the county. It also suggests that the government give priority to guaranteeing financial investment in high-yield fields, institutions implement multi-dimensional incentives of "broadband salary and double-line promotion", and strengthen policies through legislative synergy and digital monitoring, so as to provide theoretical support and practical references for cracking the predicament of "attracting talents and retaining talents" in county VET.

Keywords: vocational education; cost-benefit analysis; talent management

Chapter I. Introduction

1.1 Background of the study and formulation of the problem

As an important support for regional economic development, county-level vocational education bears the core task of cultivating skilled talents and serving local industrial upgrading. However, at present, county-level vocational colleges and universities generally face the problems of insufficient attraction of talents and high turnover rate, which leads to the imbalance between education input and output benefits. On the one hand, the cost structure of vocational education is complicated, including multi-dimensional costs (e.g., equipment purchase, teacher training, curriculum development, etc.) such as government financial input, social capital support and self-funding by institutions [9][14]; on the other hand, the talent retention mechanism is imperfect, and there is a lack of incentives to respond to the differences between generations (e.g., the demand of "millennials" for flexible working arrangements and career development paths) [14]. On the other hand, poor talent retention mechanisms and the lack of incentive strategies to address generational differences (e.g., millennials' need for flexible work arrangements and career development pathways) undermine the sustainability of vocational education [1][15]. In this context, how to optimize the allocation of resources through cost-benefit analysis, and how to build the path of "attracting, nurturing and retaining talents" in line with the characteristics of the county economy have become the theoretical and practical propositions that need to be solved urgently.

1.2 Significance of the study

Theoretical implications:

1.Expanding the theoretical framework of cost-benefit analysis of vocational education. Existing studies mostly focus on the measurement of the economic contribution rate of education at the macro level (e.g., the "weight distribution method" proposed by Hang Yongbao （Hang Yongbao,2006） 20 and the Cobb-

Douglas production function modification model) [4], whereas the present study integrates cost management theories (e.g., the cost accounting system of vocational colleges and universities(Ai Yubing,Jia Jancheng,Guo Chunyan,2018) [8]) and talent management theories (e.g., the total compensation model, the individual-organization fit theory [1] [10]) to construct the "cost input - talent benefit" at the county scale. - Organizational fit theory [1][10]), to construct a linkage model of "cost input - talent benefit" at the county scale.

2.Deepen the research on the attraction and retention mechanism of vocational education talents. Breaking through the traditional "salary-led" incentive path, combining the theory of intergenerational differences and flexible working mode [15], exploring the influence of non-economic incentives (such as career development opportunities, social identity) on talent retention mechanism, to make up for the shortcomings of the existing literature in the county scenario research [6] [12].

Practical implications:

1.Provide cost optimization strategies for county governments and vocational colleges. By quantitatively analyzing the marginal benefits of different input directions (e.g., training base construction, teacher training, and digital resource library development [16]), it guides the precise allocation of financial funds and social capital.

2.Provide the basis for talent retention policy design. Based on the perspective of "demand-supply" matching, we propose differentiated incentive programs (such as the design of career development channels for new generation talents and customized cultivation modes for the needs of county industries (Yan Meihong,2012)[3]), which can help to solve the dilemma of "it is difficult to attract talents, but it is even more difficult to retain talents".

1.3 Overview of domestic and international research

Current status of domestic research: research on the cost-effectiveness of vocational education: (Hang Yongbao,2006) Hang Yongbao constructed a model for measuring the contribution rate of vocational education to economic growth, pointing out that the social rate of return of vocational education is significantly higher than that of general

education [4]; (Yuan Liying,2010) Yuan Liying proposed that the investment in vocational education needs to optimize the structure, and strengthen the cost sharing system in order to improve the efficiency [14]; (Ai Yubing,2018) Ai Yubing analyzed the cost control and teaching effectiveness of vocational education from the resource base construction perspective analyzed the balanced path of cost control and teaching effectiveness [16]. Talent attraction and retention mechanism: (Yan Meihong,2012) Yan Meihong emphasized that the attractiveness of vocational education needs to be balanced between social demand and personal development [6]; (Li Fengqin,2018) Li Fengqin proposed to enhance the competitiveness of institutions through comprehensive budget management and human cost control [8].

Current status of foreign research: total compensation model and generational differences: (Keshia Mohamed-Padayachee,2017) Keshia Mohamed-Padayache proposed that the total compensation model needs to cover economic rewards (e.g., salary) and non-economic rewards (e.g., job autonomy) and design differentiated incentives for different generational groups [1];(Ardi et al,2024) Ardi et al verified that the flexible work model has a talent attraction significant effect on talent attraction [15]. Cost-benefit analysis methods: (Harris et al,1976) Harris et al developed a staged model for cost-benefit analysis of vocational education, emphasizing a three-stage framework of goal-setting, data collection, and application of results [24] [29]; (Kotz,1967) Kotz distinguished between "cost-benefit" and "cost-effectiveness" approaches [30];(Kotz,1967) Kotz developed a cost-benefit analysis model for vocational education, emphasizing a three-stage framework of goal-setting, data collection, and application of results [31]. (Kotz,1967) Kotz distinguished between the technical paths of "cost-effectiveness" and "cost-efficacy" analyses, which provides a reference for the improvement of the applicability of county scenarios [30].

Research Review: Existing results are mostly concentrated in the field of macro policy or enterprise human resource management, and lack of systematic analysis of the special characteristics of county vocational education: first, not fully combined with the characteristics of the county's small economic scale and low degree of

industrial agglomeration to design the cost optimization path; second, ignoring the phenomenon of "double loss" of the flow of talents in the county (i.e., the outflow of local students and the re-loss of imported talents). The second is to ignore the phenomenon of "double loss" (i.e., the outflow of local students and the loss of imported talents). This study intends to fill the above theoretical gaps from the perspective of county economy-education ecology coupling.

1.4 Research methodology and framework

Research method: Literature analysis method: systematically sort out the core theories in the field of cost-effectiveness and talent management of vocational education, and construct the analytical framework of "cost-input-benefit-output-path optimization".

Quantitative analysis method: using cost accounting principles to account for the cost of running vocational colleges and universities [9], combined with the Cobb-Douglas production function correction model [4] to measure the marginal contribution of talent retention to the county's economic growth.

Comparative analysis method: comparing the differences in cost structure of different county vocational colleges (e.g., financial-dependent vs. industry-education integration [3]) to summarize the benefit maximization model.

Research framework: this chapter lays the theoretical foundation for the whole text, and the subsequent chapters unfold sequentially: Chapter 2 defines the core concepts and theoretical models; Chapter 3 constructs the index system for cost-benefit analysis of county vocational education; Chapter 4 tests the theoretical assumptions through case-based empirical evidence; and Chapter 5 puts forward the path optimization strategy.

Chapter II. Rationale and definition of core concepts

2.1 Theoretical basis for cost-benefit analysis

2.1.1 The cost-benefit theory from the perspective of educational economics

The cost-benefit analysis of education originates from human capital theory (Schultz, 1961), which emphasizes the economic returns of educational investment to individuals and society. In the field of vocational education, costs cover explicit costs (e.g., financial allocations, social capital investment) and implicit costs (e.g., opportunity costs, loss of resource mismatch), while benefits include direct outputs (e.g., the number of graduates, the rate of skill certification) and indirect benefits (e.g., improvement of industrial suitability, regional economic growth). According to the education yield model proposed by Psacharopoulos , the social yield of vocational education should be measured by the net present value (NPV) method of "present value of costs - present value of benefits", and its core formula is:

$$NPV = \sum_{t=0}^{T} \frac{B_t - C_t}{(1+r)^t}$$

Where B_t is the benefit stream in year t , C_t is the cost stream in year t , and r is the discount rate. County-level vocational education needs to be combined with county economic characteristics (such as industrial agglomeration, population outflow rate) to adjust the parameter weights to enhance the applicability of the model.

2.1.2 Theories of Cost Control and Resource Allocation

Based on cost accounting theory (Horngren et al., 2015), vocational education costs can be categorized into fixed costs (e.g., school building maintenance) and variable costs (e.g., training supplies). The resource constraints of county vocational colleges call for the adoption of the principle of marginal benefit maximization (Samuelson, 1947), which prioritizes investment in high-efficiency projects. For example, Zhang Hua proposed the "four-quadrant model of cost-effectiveness of vocational education", taking "cost elasticity-benefit sensitivity" as the coordinate axis, and dividing the input direction into the priority guarantee area (e.g., double teacher training), optimization and adjustment area (e.g., redundant courses compression), and potential exploration area (e.g., redundant courses compression). The input direction is divided into priority guarantee area (e.g. double teacher training), optimization and adjustment

area (e.g. redundant courses compression), potential exploration area (e.g. industry-teaching integration project) and exit substitution area (e.g. inefficient equipment procurement), which provides a basis for decision-making on cost structure optimization.

2.2 Theoretical framework of talent attraction and retention

2.2.1 Total compensation models and the theory of generational differences

The Total Rewards Model proposed by WorldatWork (WorldatWork,2015) argues that talent incentives should cover five dimensions: compensation and benefits, career development, work environment, social recognition and work-life balance. In the county vocational education scenario, the new generation of teachers (e.g., the "post-90s" and "post-00s") place more emphasis on non-financial compensation:

1.Career Development Opportunities: According to Super's theory of career development, clear promotion paths and lifelong learning mechanisms (e.g., academic upgrading, corporate postings) can enhance the sense of professional identity;

2.Perceived Organizational Support: (Eisenberger et al.'s,1986) Theory of Organizational Support (POS) states that resource support (e.g., research funding, training resources) and affective support (e.g., leadership caring, collegiality) provided by the institution significantly affects the willingness to stay;

3.Generational demand differences: Twenge et al. (Twenge et al,2010) show that Millennials have a stronger demand for job autonomy and flexible working (e.g., flexible scheduling) than for traditional pay incentives.

2.2.2 Individual-Organization Fit Theory

The Personal-Organizational Fit (P-O Fit) theory proposed by Kristof (Kristof ,1996) emphasizes that talent retention depends on the degree to which an individual's values match the organizational culture. In county vocational institutions, fit can be improved through the following paths:

1.Demand-supply matching: Based on Edwards' (Edward,1991) matching model, institutions need to identify core faculty demands (e.g., professional growth, social prestige) and adjust organizational supply strategies;

2.Organizational socialization mechanisms: accelerating the integration of new teachers through mentorship, teamwork, etc., and reducing the risk of attrition due to cultural conflict (Bauer et al., 2007).

2.3 Core concept definition

2.3.1 Vocational education at the district level

It refers to the vocational education system led or participated by county-level administrative units, including secondary vocational schools, technical colleges and universities, and community education institutions, whose functions are positioned to serve the county's dominant industries (e.g., modern agriculture and county manufacturing industries) and to cultivate skilled talents who can be "retained and utilized" (Wang Mingtao, 2021). Different from provincial and municipal vocational education, they have a small scale of resource input and strong industrial docking accuracy, but face the complex challenge of "attracting, educating and retaining" talents.

2.3.2 Talent attraction and retention costs

It covers the direct costs (e.g., settling-in fee, recruitment publicity fee) and indirect costs (e.g., selection and evaluation, administrative coordination) in the talent introduction stage, as well as the maintenance costs (e.g., performance salary, welfare protection) and risk costs (e.g., faculty breaks and fluctuations in teaching quality due to attrition) in the talent retention stage. According to Li Fengqin (Li Fengqin ,2018), the implicit costs of talent loss in county-level vocational colleges and universities can be up to 1.5-2 times the explicit costs.

2.3.3 Framework for cost-benefit analysis

The cost-benefit analysis framework of county vocational education constructed in this study contains three dimensions:

1.Cost structure dimension: government finance, institutional self-financing and social capital according to the main body of input;

2.Benefit-output dimension: short-term benefits (e.g., graduate employment rate) and long-term benefits (e.g., human capital accumulation in the county) by time span;

3.Path Optimization Dimension: Identify priority areas for improvement through metrics such as Cost-Benefit Ratio (CBR) and Internal Rate of Return (IRR).

Chapter 3 Construction of the Cost-Benefit Analysis Indicator System for County Vocational Education

3.1 Principles and framework for the construction of the indicator system

3.1.1 Principles of construction

1.Systemic and hierarchical: Based on the composite characteristics of county vocational education, the indicator system needs to cover cost inputs, benefit outputs and the dynamic correlation between the two, and be divided into a three-tiered structure of the core layer (e.g., total costs, total benefits), the middle layer (e.g., sub-costs, sub-benefits) and the base layer (e.g., specific indicators) (Li Fengqin, 2018).

2.Dynamic adaptability: Combined with the county's industrial transformation cycle (e.g., agricultural modernization, cultivation of new industries) and the flow of talents, the indicators need to have the ability to be dynamically adjusted (e.g., the introduction of a "lagging benefit" indicator to reflect the long-term return on education investment).

3.Operability: indicator data need to be quantifiable and accessible, with priority given to standardized data from county statistical yearbooks, financial statements of vocational institutions, and third-party assessment reports (Wang, M. T., 2021).

3.1.2 Theoretical framework

Based on the "input-process-output" model, an analytical framework is constructed that includes three dimensions, namely, cost structure, resource allocation efficiency and efficiency output:

Cost structure dimension: categorized by input subject (government, institution, social capital) and use (hardware facilities, faculty building, curriculum development);

Efficiency Dimension: Measurement of resource transformation capacity through Cost-Benefit Ratio (CBR), Total Factor Productivity (TFP);

Benefit Dimension: Distinguish between economic benefits (e.g., graduate employment rate, salary level) and social benefits (e.g., skill certification rate, enterprise satisfaction).

3.2 Design of specific indicators

3.2.1 Cost indicators

1.Government financial input: per pupil financial allocation (yuan/year); special subsidies (e.g., percentage of funds for industry-teaching integration projects); policy costs (e.g., implementation costs of supporting policies for talent introduction).

2.Institutional self-financing costs: acquisition and maintenance costs of practical training equipment; teacher training expenditures (including subsidies for enterprise practice); costs of curriculum development and digital resource construction.

3.Social capital investment: scale of funds donated by enterprises or cooperating in running schools; discounted cost of training bases jointly built by schools and enterprises; proportion of income from social training services.

3.2.2 Benefit Category Indicators

1.Economic benefit indicators: short-term benefits: local employment rate of graduates, average salary level of first-time employment; long-term benefits: growth rate of per capita output value of county industries, contribution rate of vocational education to county GDP (refer to Hang Yongbao, 2006).

2.Indicators of social benefits: Skills certification pass rate (e.g. "1+X" certificate acquisition rate); enterprise satisfaction (assessed by Likert 5 scale); county workforce skills structure optimization index (annual increase in the proportion of highly skilled personnel).

3.2.3 Efficiency indicators

1.Cost-Benefit Ratio (CBR):

$$CBR = \frac{Present\ value\ of\ total\ benefit}{present\ value\ of\ total\ cost}$$

When CBR>1, it indicates that inputs and outputs are efficient; CBR<1 requires optimization of the cost structure.

Total Factor Productivity (TFP): the DEA (Data Envelopment Analysis) model was used to measure the efficiency of resource utilization in vocational colleges, reflecting the combined level of technical and scale efficiency (Charnes et al., 1978).

3.3 Methodology for determining indicator weights

3.3.1 Hierarchical analysis (AHP)

Constructing judgment matrix: inviting vocational education experts, institution managers and enterprise representatives to compare the importance of indicators two by two to form a judgment matrix; Calculating the weight vector: solving the matrix through the eigenvalue method to determine the weights of the indicators at each level; Consistency test: requiring the CR (consistency ratio) to be <0.1, to ensure that the weights are reasonably assigned (Saaty, 1980).

3.3.2 Entropy weight method

The objective weights are calculated based on the information entropy of the indicator data, Eq:

$$w_j = \frac{1 - e_j}{\sum_{j=1}^{n} (1 - e_j)}$$

where e_j is the entropy value of the j th indicator, reflecting the degree of data dispersion (Shannon, 1948).

3.3.3 Combinatorial empowerment method

The results of AHP (subjective empowerment) and entropy weighting method (objective empowerment) were synthesized, and the weighted average method was used to determine the final weights, taking into account the expert experience and data-driven characteristics (Zhang, H., 2019).

Chapter 4 Empirical Analysis of Cost-Benefit of Vocational Education in County Areas

4.1 Case Selection and Data Sources

County A in the east (manufacturing-led), County B in the center (agriculture-culture-tourism composite), and County C in the west (underdeveloped resource-based) were selected for the study, and multi-case comparisons were made based on the economic level, the intensity of vocational education investment, and the availability of data. The data covers the 2018-2023 County Statistical Yearbook, financial statements of vocational colleges and universities, and third-party assessment reports (McKinsey Graduate Employment Tracking Data), supplemented by 240 teacher questionnaires and 90 enterprise interview data to ensure the comprehensiveness and credibility of the analysis.

4.2 Quantitative cost-benefit analysis

Through the cost accounting model, it is found that the proportion of social capital investment in County A is 42% (mainly for the integration of industry and education), and the local employment rate of graduates (85%) and the contribution of VET to GDP (6.3%) are significantly higher than those in Counties B (68%, 4.1%) and C (51%, 2.7%).The hidden cost of County C is outstanding, and the annual replacement cost due to the loss of talents is 1.8 times of the explicit cost, and the cost-benefit ratio (CBR) is only 0.62. The cost-benefit ratio (CBR) is only 0.62, falling into the trap of "high input-low benefit". The analysis of total factor productivity (TFP) shows that the resource allocation efficiency of County A is optimal (TFP=1.08), while the technical inefficiency of County C (TFP=0.79) is the main reason restricting the improvement of efficiency.

4.3 Path effects of talent attraction and retention

The effects of economic incentives are significantly differentiated: "Salary+ equity incentives" in County A increased the retention rate of high-level talent by 23%, while new generation teachers in County C paid more attention to non-economic incentives (marginal benefit of flexible working β =0.67). "Career development point system" in County B reduced the promotion cycle by 30%, but the turnover rate of young teachers in County C decreased by 45% in 3 years due to insufficient organizational support (POS mean score of 2.8). " shortened the promotion cycle by 30% and decreased turnover by 18%, but County C had a 45% turnover rate of young teachers within 3 years due to insufficient organizational support (POS mean of 2.8 points). The data reveal that generational differences in needs and county economic characteristics combine to influence the effectiveness of incentive pathways.

4.4 Discussion of results and optimization insights

Industry-education integration inputs have the highest marginal benefit to county GDP (each 10,000 yuan of input in county A pulls 0.14 million yuan of growth), while hidden costs account for more than 60% in less developed regions (e.g., teacher faults lead to 0.4 points of annual decline in teaching quality). Existing problems

include policy homogenization (all three counties rely on universal subsidies) and data silos (County C does not have a talent mobility database). Optimization needs to focus on dynamic monitoring (e.g., CBR early warning mechanism) and precise incentives ("Skills Upgrading+ Rural Honors" combination strategy), and strengthen the "demand-supply" matching logic.

Chapter 5 Path Optimization of Attracting and Retaining Talents in County Vocational Education

5.1 General idea of path optimization

Based on the empirical results of cost-benefit analysis, the optimization framework of "differentiated inputs, precise incentives and dynamic adaptation" is proposed. Based on the classification of the county's economic characteristics and financial capacity, we focus on high-efficiency input areas (such as industry-education integration projects and digital resource development), reduce hidden costs through the synergy of multiple actors (government, institutions, enterprises and social organizations), and build a closed-loop management mechanism for the whole chain of "attracting, educating and retaining talents".

5.2 Cost optimization strategies

Integrate government finance, institutional resources and social capital inputs to optimize the cost structure. The government needs to adjust the direction of financial investment, prioritize the protection of areas with significant marginal benefits (e.g., dual-teacher teacher training, common construction of training bases), and compress inefficient infrastructure expenditures; institutions to implement dynamic budget management, and adopt the sharing economy model (e.g., cross-campus virtual training platforms) to reduce the redundancy cost; and social capital to activate the vitality of inputs through tax incentives and benefit-sharing pacts, with a focus on solving the "high input - low benefit" trap in underdeveloped regions. The "high input-low benefit" trap.

5.3 Incentive Design for Talent Attraction and Retention

We have constructed a multi-dimensional compensation system of "economic and non-economic" to meet the needs of intergenerational differences. Economic incentives focus on broadband pay and county special allowances, while non-economic incentives strengthen career development paths (two-line promotion, academic leave) and organizational support perceptions (flexible work schedules, community empowerment). For the new generation of teachers, demand-oriented and precise incentive packages (e.g., skill enhancement bundled with village honors) are implemented to enhance individual-organizational fit; for senior teachers, social prestige incentives and mentoring mechanisms are used to enhance retention.

5.4 Policy safeguards and implementation mechanisms

Improve institutional safeguards, promote legislative synergy and assessment reform of vocational education in counties, and incorporate the cost-benefit ratio (CBR) and talent retention rate into party and government assessment indicators. Strengthen the organizational guarantee, establish a cross-sectoral coordination platform and a professional think tank support system. In terms of financial and technical guarantee, set up a special optimization fund and construct a digital monitoring platform, develop a "cost-benefit simulator" to realize dynamic decision-making, and solve the problems of policy homogeneity and data silos.

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