Construction of Youth Night School Education Model in Higher Vocational Colleges Based on Multi-Layer Perceptron Algorithm and Its Empowerment Path for Local Economy

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ABSTRACT Higher vocational colleges possess resource endowments for skill-oriented community education. Taking such colleges as the primary organizers of Youth Night Schools helps expand the service boundary of vocational education and strengthen the supply capacity of skill training for urban young people. To tackle two prominent obstacles—the lack of quantitative evaluation tools for educational models and ambiguous mechanisms of local economic empowerment—this study proposes an evaluation framework centered on the Multi-Layer Perceptron (MLP) algorithm. An indicator system is established covering curriculum design, faculty allocation, practical training facilities and other dimensions. A neural network architecture is constructed, where hidden-layer feature extraction enables nonlinear fitting of operational performance. Combined with an analysis of industrial talent demand, the correlation between evaluation outputs and regional employment structure is further explored. The proposed evaluation model delivers favorable fitting accuracy and generalization capability, which can provide decision-making support for higher vocational colleges to optimize curriculum provision and deepen college-local coordination.

INDEX TERMS Higher Vocational Colleges; Youth Night School; Multi-Layer Perceptron; Educational Model; Local Economic Empowerment

I. INTRODUCTION

In recent years, skill-focused evening courses for employed young adults have sprouted up in numerous cities, emerging as a new form linking career advancement and spare-time learning and arousing strong enthusiasm among youth participants. Higher vocational colleges are equipped with practical training equipment, dual-qualified teachers and industry-education integration channels, placing them in an advantageous position to deliver such educational services. Nevertheless, the construction of relevant operational models remains in the exploratory stage, without unified standards or quantitative evaluation instruments to quantify the matching relationships between curriculum provision, faculty input and operational outcomes. Existing research mostly focuses on vocational education quality assessment or the evolution of night school development, while few studies integrate neural network algorithms with night school performance evaluation and local economic driving effects. Therefore, clarifying the transmission mechanism between educational supply and industrial demand carries substantial practical significance.

II. THEORETICAL FOUNDATION AND CONNOTATION DEFINITION OF YOUTH NIGHT SCHOOL EDUCATION MODEL IN HIGHER VOCATIONAL COLLEGES

A. ORIGIN AND EDUCATIONAL FUNCTIONAL POSITIONING OF YOUTH NIGHT SCHOOL

Evolving from the established traditions of urban lifelong learning and community education, Youth Night Schools initially took shape as interest-based evening courses hosted by cultural centers and mass art institutions. In recent years, they have gradually shifted toward skill upgrading, forming a new type of educational supply targeting employed young adults during their spare time [1]. Unlike traditional night schools catering to elderly groups and academic education for credential acquisition, Youth Night Schools impose no entry thresholds, feature short-cycle modular courses, and allow participants to select classes independently based on their career development needs, combining personal interest expansion and vocational skill upgrading.

Functionally, Youth Night Schools do not replace the formal academic education system of higher vocational colleges; instead, they act as a bridge between degree programs and fragmented self-directed learning. They fill the gap that prevents employed young adults from accessing systematic training due to time constraints, and offer a low-barrier trial learning channel for participants to transition into formal vocational training or continuing education later. Most participants are working young adults with steady incomes, whose learning motivations differ from full-time students pursuing examinations or job placement. They primarily seek to ease career-related anxiety and pursue self-improvement. This positioning dictates that Youth Night School curricula must balance general accessibility and vocational relevance, avoiding overly superficial interest courses while complementing rather than duplicating the formal degree programs of higher vocational colleges. This internal rationality justifies the role of higher vocational colleges as core organizers of Youth Night Schools.

B. MATCHING BASIS BETWEEN HIGHER VOCATIONAL COLLEGE RESOURCES AND YOUTH NIGHT SCHOOL CONSTRUCTION

Higher vocational colleges have long cultivated technical and skilled talents for industries, accumulating educational resources highly compatible with Youth Night School curriculum demands. In terms of practical training infrastructure, professional training bases, production-oriented workshops and simulation teaching equipment affiliated with various specialty clusters can be opened to the public during non-teaching hours, supporting hands-on skill instruction without additional procurement. For faculty, dual-qualified teachers integrate theoretical teaching competence and corporate practical experience, forming a more stable and professionally matched teaching workforce compared with traditional night schools reliant on external part-time instructors.

In terms of industry-education integration channels, established school-enterprise partnerships, customized training programs and post internship networks enable Youth Night School participants to observe and practice in real workplace scenarios, moving beyond purely theoretical instruction. In addition, most higher vocational colleges operate continuing education schools or community education divisions with mature experience in student recruitment, class scheduling and student status management for non-full-time learners, lowering the marginal costs of building a complete Youth Night School operation system from scratch. These resource endowments align closely with the core requirements of Youth Night Schools for venues, instructors and industrial linkages, making higher vocational colleges more suitable than cultural centers or community colleges to take primary responsibility for construction and laying a practical foundation for the subsequent development of educational models.

C. EDUCATIONAL MODEL CONSTRUCTION LOGIC SUPPORTED BY DIGITAL INTELLIGENT TECHNOLOGY

Traditional educational model development relies heavily on managerial experience and expert review, making it difficult to quantitatively verify matching relationships between curriculum frameworks, faculty allocation and training resources. This introduces subjective biases in the design phase, with subsequent adjustments often lagging behind real operational feedback. Digital intelligent technologies offer an alternative construction path: by converting indicators such as curriculum coverage, faculty investment intensity, training facility allocation and student feedback into quantifiable structured data, algorithmic models can map input factors to operational outcomes. This transforms model development from qualitative experiential description into a verifiable, iterable quantitative process [2].

Under this logic, the Youth Night School educational model is not a static one-time design, but a dynamically cyclical process of data collection, model evaluation and feedback adjustment. Outputs from the evaluation model can verify the rationality of existing curriculum arrangements and prioritize resource allocation. Moreover, unlike manual multi-indicator comparison, algorithmic models simultaneously process multi-dimensional nonlinear factor relationships and reduce omissions caused by excessive evaluation dimensions. This data-driven logic tightly integrates model design and operational assessment, demonstrating both theoretical necessity and practical feasibility for adopting Multi-Layer Perceptron algorithms to build quantitative evaluation tools.

III. CONSTRUCTION OF YOUTH NIGHT SCHOOL EDUCATIONAL QUALITY EVALUATION MODEL BASED ON MULTI-LAYER PERCEPTRON ALGORITHM

A. DIMENSIONAL DESIGN AND WEIGHT DETERMINATION OF EDUCATIONAL QUALITY EVALUATION INDICATOR SYSTEM

A comprehensive educational quality evaluation indicator system must cover core operational elements to avoid distorted evaluation results stemming from incomplete dimensions. Combined with the operational characteristics of Youth Night Schools in higher vocational colleges and existing research on vocational education quality assessment [3], this study establishes four primary dimensions: curriculum design, faculty allocation, practical training conditions and public recognition.

The curriculum design dimension measures curriculum coverage range, update frequency and alignment with vocational demands, reflecting the degree of matching between supply-side offerings and industrial talent needs. The faculty allocation dimension incorporates the proportion of dual-qualified teachers, average practical guidance tenure and student-teacher ratio to quantify professional teaching capacity. The practical training dimension assesses equipment utilization rate, weekly venue opening hours and industrial compatibility to evaluate hands-on teaching support

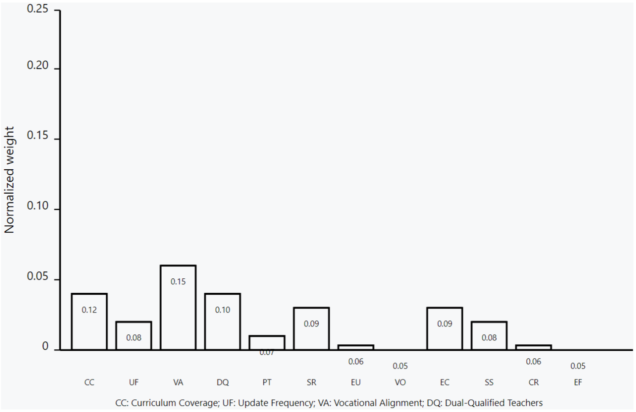

Fig. 1. Weights of Secondary Indicators in the Youth Night Schooleducational Quality Evaluation System (Derived from AHP)

capacity. The public recognition dimension relies on student satisfaction, course completion retention rate and corporate employer feedback to capture external assessments of operational performance.

Data for all secondary indicators are sourced from academic administration records, questionnaire surveys and corporate follow-up interviews. After standardization, Analytic Hierarchy Process combined with expert consultation is adopted to assign relative weights to each indicator. This method avoids the neglect of industrial experience inherent to purely objective weighting and eliminates randomness from subjective scoring alone. The dimensional division and weight structure of the indicator system directly correspond to input layer nodes of the subsequent MLP model, with detailed indicators presented in Table 1.

Normalized secondary indicator weights calculated via AHP are presented in Figure 1. Vocational Alignment (VA) bears the maximum weight, proving curriculum-post matching is the core factor governing Youth Night School performance. Dual-Qualified Teachers (DQ), Student Satisfaction (EC) and Skill Reserve (SR) also hold notable weights, while venue hours and equipment compatibility rank lower. This suggests participants value practical curricula and instruction above hardware conditions, and offers support for configuring input nodes of the following MLP model.

B. NETWORK STRUCTURE DESIGN AND PARAMETER OPTIMIZATION OF MULTI-LAYER PERCEPTRON

As a feedforward neural network, Multi-Layer Perceptrons employ nonlinear transformations in hidden layers to capture complex relationships between input indicators and comprehensive evaluation scores, making them suitable for fitting how multi-dimensional factors including curriculum design and faculty allocation shape operational performance. Previous research by Jia Wenya et al. on vocational education quality evaluation has validated the applicability of this method [4], [5].

The number of input layer nodes matches the count of secondary indicators listed in Table 1; all normalized indicator data are fed into the model to eliminate interference from inconsistent dimensions. A single hidden layer is adopted, with node quantity determined through empirical formulas and repeated trial calculations to balance fitting performance and computational complexity. The output layer contains a single node generating a composite score for educational model operation. For activation functions, the Rectified Linear Unit (ReLU) is applied to the hidden layer to mitigate vanishing gradients and accelerate convergence. The Sigmoid function is used for the output layer to normalize evaluation scores within a unified range. The Adam optimizer dynamically adjusts learning rates to stabilize convergence, while L2 regularization suppresses overfitting to training samples and improves generalization to unseen data. Detailed network architecture and core parameter configurations are shown in Table 2, with fine-tuning implemented based on convergence performance during subsequent model training.

C. TRAINING MECHANISM AND RESULT VERIFICATION OF THE EVALUATION MODEL

Prior to model training, all sample data are partitioned into training set, validation set and test set according to fixed proportions. The training set serves for iterative parameter updating, the validation set monitors convergence trends and assists hyperparameter tuning, while the test set independently evaluates the overall performance after training to avoid overly optimistic results induced by improper sample segmentation. The training process alternates between forward propagation and backpropagation. In forward propagation, predicted evaluation scores are calculated using current weight matrices. In backpropagation, connection weights between layers are adjusted layer by layer based on gradients of the loss function. Mean Square Error (MSE) is adopted as the loss metric to quantify deviations between model outputs and target scores.

An early stopping strategy is introduced to mitigate overfitting on the training dataset and preserve the model's generalization ability. If the loss value on the validation set fails to decline over successive training rounds, the iteration process terminates, and the parameter combination delivering the best validation performance is retained as the final model [6], [7]. For result verification, consistency comparison is conducted between outputs generated by the proposed model, expert scoring results and calculation values derived from the Analytic Hierarchy Process (AHP). The coefficient of determination and root mean square error are computed to measure fitting precision. K-fold cross-validation is further implemented to examine the model's stability across distinct data subsets, which helps judge whether the evaluation system can be generalized to samples from other vocational colleges.

If the deviation range of verification results from each fold stays within an acceptable threshold, it can be concluded that the fitting relationship between the model and variables including curriculum arrangement and faculty allocation is

TABLE 1. Educational Quality Evaluation Indicator System for Youth Night Schools in Higher Vocational Colleges

Primary Dimension	Secondary Indicator	Indicator Description
Curriculum Design	Curriculum Coverage Range	Number of industrial sectors and skill categories covered by offered courses
Curriculum Design	Curriculum Update Frequency	Proportion of curriculum library content revised or replaced each semester
Curriculum Design	Vocational Alignment Degree	Matching level between course content and corresponding post skill standards
Faculty Allocation	Proportion of Dual-Qualified Teachers	Share of instructors with both formal teaching credentials and corporate practical experience
Faculty Allocation	Average Practical Guidance Tenure	Mean years of corporate practice or technical instruction among teachers
Faculty Allocation	Student-Teacher Ratio	Number of students per instructor per class hour
Practical Training Conditions	Equipment Utilization Rate	Proportion of weekly training facility hours allocated to Youth Night School courses
Practical Training Conditions	Weekly Venue Opening Hours	Average weekly hours training facilities are accessible to night school participants
Practical Training Conditions	Industrial Equipment Compatibility	Matching level between on-campus equipment and mainstream industrial technologies in participants' industries
Public Recognition	Student Satisfaction	Scored evaluations of course content and teaching methods submitted by participants
Public Recognition	Course Completion Retention Rate	Proportion of graduates who continue enrolling in subsequent night school programs
Public Recognition	Corporate Employer Feedback	Evaluations of graduates' practical skill performance submitted by hiring enterprises

TABLE 2. Network Architecture and Core Parameter Settings of Multi-Layer Perceptron

Parameter Category	Configuration Approach	Design Explanation
Input Layer Node Count	Matches secondary indicator quantity in Table 1	Normalized indicator data serve as input variables
Hidden Layer Quantity	Single hidden layer	Balances model fitting capacity and computational overhead
Hidden Layer Node Count	Determined via empirical formulas and trial training	Prevents overfitting from excessive nodes
Output Layer Node Count	Single node	Outputs composite operational evaluation score of the educational model
Hidden Layer Activation Function	ReLU	Alleviates vanishing gradients and speeds up convergence
Output Layer Activation Function	Sigmoid	Normalizes output scores to a unified numerical interval
Optimization Algorithm	Adam Optimizer	Dynamically adjusts learning rates for stable convergence
Regularization Strategy	L2 Regularization	Restrains overfitting to training dataset samples
Training Termination Criterion	Early Stopping Mechanism	Training halts if validation set loss fails to decline over consecutive iterations

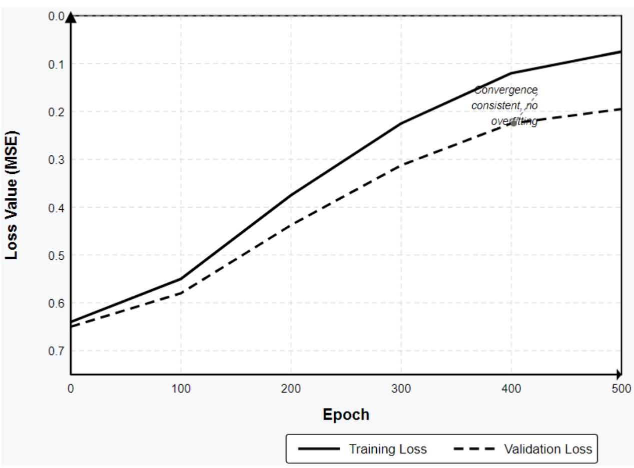

Fig. 2. Training Loss and Validation Loss Convergence Curves of MLP

not a coincidental feature unique to the training samples. This provides quantitatively validated evidence for subsequent correlation analysis with industrial talent demands. The changes in training loss and validation loss with training epochs are plotted in Figure 2. Both loss curves show a steady declining trend and maintain a narrow gap throughout iterations. No obvious divergence between the two curves is observed, which verifies that the MLP model with L2 regularization and early stopping avoids severe overfitting and achieves stable convergence. The trained network possesses favorable generalization capacity for unknown samples.

IV. COLLABORATIVE MECHANISM BETWEEN YOUTH NIGHT SCHOOL EDUCATION MODEL AND REGIONAL INDUSTRIAL TALENT DEMAND

A. ANALYSIS ON STRUCTURAL DEMAND FOR SKILLED TALENTS BROUGHT BY LOCAL INDUSTRIAL TRANSFORMATION

The transformation and upgrading of regional industries have reshaped the structural demand for job skills. Traditional manufacturing posts that rely on single operational competence are gradually giving way to compound and digital skill requirements. The expansion of emerging and characteristic industries including advanced equipment manufacturing, e-commerce and live-stream economy, as well as ice-snow industries, has further widened the gap in the supply of skilled personnel [8]. Formal academic education usually requires two to three years to cultivate talents, which fails to respond to short-term, periodic skill shortages caused by adjustments to industrial structures. Most employed young people already possess basic professional foundations, and their demands for skill upgrading focus on targeted, short-cycle supplementary training, creating a mismatch with the positioning of systematic academic education.

Supported by modular courses and flexible class schedules, Youth Night Schools can deliver training for specific skill directions within a short timeframe, bridging the gap between long training cycles and rapid industrial demand responses. Moreover, compared with scattered pre-job training launched independently by enterprises, standardized courses organized by higher vocational colleges feature better systematicness and sustainability. Clarifying the specific talent demands generated by regional industrial transformation serves as a prerequisite for determining core directions of Youth Night School curriculum development. Researchers need to combine local key industrial plans, enterprise job

TABLE 3. Network Architecture and Core Parameter Settings of Multi-Layer Perceptron

Industrial Sector	Vocational Skill Orientation	Elderly Care & Health Management
Advanced Equipment Manufacturing	NC Programming & Equipment Maintenance	Elderly Care & Health Management
E-commerce & Live-stream Economy	Content Operation & New Media Marketing	Short Video Shooting and Editing, E-commerce Operation Practices
Ice-snow Economy	Venue Service & Event Support	Basic Ice-snow Sports Guidance, Stadium Operation and Management
Pension & Health Services	Elderly Care & Health Management	Elderly Care Skills, Fundamentals of Health Management
Deep Processing of Agricultural Products	Elderly Care & Health Management	Food Processing Technology, Quality Inspection and Traceability

descriptions and human resource market monitoring data to identify changing trends in vocational skill requirements. This provides practical support for dynamically matching curriculum content with post standards and prevents curricula from becoming detached from industrial realities and merely formalistic.

B. DYNAMIC MATCHING MECHANISM BETWEEN CURRICULUM CONTENT AND POST SKILL STANDARDS

The alignment of curriculum content and vocational skill standards must follow clear conversion rules rather than subjective judgments of administrators. In practice, researchers decompose competency requirements of various posts into teachable skill units in accordance with national vocational skill standards and industrial competency lists. Curriculum modules with corresponding class hours are then assembled based on these skill units, establishing direct correspondence between teaching content and real operational requirements at workplaces [9].

This conversion process cannot be completed in a one-off manner. Updates in industrial technologies and changes in post requirements demand a dynamic adjustment mechanism for curriculum banks. Operators shall regularly collect post monitoring data and employment feedback from key local industries to identify deviations between existing curriculum modules and practical skill demands, then add or eliminate corresponding teaching content accordingly. This avoids stagnant teaching plans that lag behind industrial progress after long-term implementation. Meanwhile, curriculum modules are divided to meet differentiated demands across various industrial sectors, enabling participants to select targeted course combinations matching their own industries instead of receiving generalized general training. Rooted in vocational skill standards and featuring dynamic updates, this matching mechanism ensures Youth Night School curriculum supply consistently fits local industrial realities, rather than relying on fixed teaching plans formulated once at the launch of the school. Table 3 illustrates the correspondence between curriculum modules and post skills in typical industrial sectors.

C. CONSTRUCTION OF MULTI-STAKEHOLDER COLLABORATIVE EDUCATION MECHANISM INVOLVING VOCATIONAL COLLEGES, ENTERPRISES AND COMMUNITIES

Matching curriculum content with post standards solves the core issue of "what to teach", yet sustainable operation of the education model relies on role division and coordination among three parties: higher vocational colleges, enterprises and communities [10], [11]. Higher vocational colleges act as the main executing body, responsible for curriculum development, faculty coordination and teaching venue provision. Local enterprises supply real workplace scenarios and technical guidance, participate in curriculum review, and offer internships or employment opportunities for outstanding trainees to create industrial transformation channels for teaching outcomes. Communities and mass organizations rely on their resident-oriented publicity networks to undertake student recruitment, venue coordination and partial financial support, making up for vocational colleges' limited reach to potential participants.

Tripartite collaboration cannot be limited to temporary cooperation. Joint councils or regular liaison meetings shall be established to clarify rights and obligations of all parties, supported by concrete measures including mutual faculty employment and shared training bases. Such arrangements prevent superficial cooperation marked by mere signing ceremonies. Clear cooperation cycles and assessment standards are formulated to avoid breakdowns in collaborative ties caused by personnel transfers or expiration of short-term projects. In-depth enterprise participation in curriculum review and teaching processes can timely transmit dynamic changes in post skill standards to curriculum development links. This connects with the aforementioned curriculum update mechanism, forming a closed loop supported by demand identification, curriculum adjustment and collaborative education, and laying organizational foundations for the education model to generate tangible driving effects on local economy.

V. ECONOMIC EMPOWERMENT EFFECTS AND OPERATIONAL GUARANTEES OF THE YOUTH NIGHT SCHOOL EDUCATION MODEL

A. LABOR SKILL SUPPLY AND OPTIMIZATION OF REGIONAL EMPLOYMENT STRUCTURE

After matching Youth Night School curricula with industrial post demands, the most direct effect lies in the improvement of employed youths' skill levels, which further generates transmission impacts on regional employment structures [12], [13]. Many regions simultaneously face two structural contradictions: insufficient supply of skilled talents and surplus labor in shrinking traditional posts. Skill deficiencies constitute a major barrier blocking smooth labor mobility from declining sectors to expanding industries. Targeted courses can make up workers' weaknesses in digital operation and compound competencies, lowering skill thresholds for job transfers or promotions. This reduces hidden unemployment and post mismatches caused by gaps between personal skills and job requirements, improves resource allocation efficiency of regional labor markets, and indirectly cuts enterprises' extra recruitment costs incurred by hiring talents from outside local areas.

The aforementioned evaluation model is not merely used for internal monitoring of teaching quality; its output results can also serve as quantitative tools to observe changes in skill supply structures. By continuously tracking covered curriculum directions and graduation destinations of participants, managers can identify structural mismatches between skill supply and industrial demands, then feed relevant findings back into curriculum development and collaborative education links. This creates a verifiable, traceable correlation mechanism linking educational supply and employment structure optimization, instead of staying at the level of qualitative experiential description.

B. TRANSFORMATION AND UPGRADING OF MICRO, SMALL AND MEDIUM-SIZED ENTERPRISES AND SUPPORT FOR INDUSTRIAL INNOVATION

During industrial transformation, micro, small and medium-sized enterprises (MSMEs) also face pressures of skill replenishment. Restricted by limited training budgets and internal teaching teams, they cannot establish systematic training systems independently like large corporations [14], [15]. Relying on existing teaching resources and venues of higher vocational colleges, Youth Night Schools provide skill courses for employees of MSMEs at low costs. Enterprises can obtain stable talent supply channels by sending staff to training without bearing fixed costs for independent school operation. This alleviates skill shortages arising from equipment renewal and process upgrading, and especially reduces the burden of MSMEs that cannot spread fixed training costs due to small employee scales.

Beyond talent supply, open training venues and teacher-student interactions at vocational colleges create channels for enterprises to access scientific research and teaching resources of schools. Partial demands for process improvement or workflow optimization can receive preliminary responses through joint school-enterprise training, producing spillover effects that extend educational supply to industrial innovation activities [16]. This model, where educational institutions undertake corporate training functions at low costs, fits regional industrial structures dominated by MSMEs with insufficient internal training resources. It expands the service radius of vocational education resources beyond full-time academic students to a wider range of local economic entities, building mutually supportive interactions between educational supply and industrial innovation.

C. INSTITUTIONAL GUARANTEE SYSTEM FOR SUSTAINABLE OPERATION OF THE EDUCATION MODEL

If the education model only relies on phased investment to sustain operation, it cannot continuously deliver the above-mentioned effects of skill supply and industrial support. A stable guarantee system covering funding, organization, policy and quality dimensions must be established, freeing model operation from reliance on individual leaders' attention or short-term special funds. In terms of funding, diversified financing channels combining special government funds, reasonable cost-sharing by participating enterprises and low-fee student charges can avoid operational interruptions caused by single-source funding.

For organizational management, higher vocational colleges should set up industry-education integration centers or dedicated administrative departments to coordinate curriculum development, faculty allocation and college-enterprise-community communication, clarifying institutional responsibilities instead of relying on ad-hoc working groups. From the policy perspective, Youth Night Schools shall be incorporated into local vocational education development plans. Moderate venue or tax incentives shall be provided to participating enterprises to boost their willingness for long-term engagement. In the quality dimension, the aforementioned Multi-Layer Perceptron evaluation model shall be embedded into regular monitoring mechanisms. Evaluations shall be conducted semesterly or annually, with results adopted to iterate curricula. This ensures the whole model stays verifiable and adjustable in operation rather than rigidly implementing static schemes. The four interrelated guarantee dimensions jointly maintain stable operation capacity of the education model amid college-local coordination and industrial changes, ultimately serving long-term local economic development.

VI. CONCLUSION

Higher vocational colleges taking the lead in constructing Youth Night Schools not only respond to diversified learning demands of employed young people, but also expand the service scope of vocational education. Introducing the Multi-Layer Perceptron algorithm into educational model evaluation enables quantitative measurement of operational effects generated by curriculum design, faculty allocation, training facilities and other factors, making up for the defects of previous experience-based judgment and providing objective references for curriculum adjustment and resource allocation. Once the correlation between educational supply and industrial talent demand is clarified, Youth Night Schools will not only serve individual skill improvement, but also feed back into the optimization of regional employment structures through upgraded labor quality, carrying practical significance for transformation regions suffering from brain retention pressure. Subsequent research can adopt long-cycle operational data to test the applicability of the evaluation model across different regions.

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