Constructing a Digital Talent Supply Index in AI-Enabled Vocational Education Scenarios "A Statistical Evaluation Approach Based on Multi-Source Teaching Big Data Case"

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Abstract: As the demand for digitally skilled workers continues to grow, vocational education has become increasingly important in preparing learners for a changing labour market. Existing approaches to talent assessment, however, are often limited by fragmented data, subjective judgement, and delayed feedback. This study therefore proposes a practical indicator system derived from authentic records generated by AI-enabled classrooms and multiple institutional databases. The framework covers four dimensions: teaching resources, the digital competencies of teachers and students, the use and effects of AI in classroom practice, and graduates' performance in the workplace. Because most of the required information is already collected by vocational institutions, the framework can be incorporated into routine teaching and administrative processes. It can also be refreshed as new records become available, allowing digital talent supply to be evaluated on an ongoing basis. We used entropy-weight calculation. Basic weighted-sum math gave our final index scores. Put these datasets together. You see the true state of local digital-talent training.

Keywords: AI Empowerment; Higher Vocational Education; Digital Talent; Supply Index; Multi-Source Big Data; Statistical Evaluation

1. Introduction

With the deep integration of artificial intelligence technologies into vocational education, higher vocational teaching scenarios have entered a new phase of digital and intelligent transformation, making digitally skilled talents a core human resource for industrial digital upgrading. The Implementation Plan of the Digital Strategic Action for Vocational Education [1] explicitly calls for the establishment of a digital talent cultivation evaluation system that leverages big data technologies to achieve dynamic monitoring and precise assessment of talent quality. At present, domestic evaluations of digital talent supply in higher vocational institutions tend to focus on individual teaching segments or final output outcomes, suffering from problems such as single-dimensional indicators, excessive subjective weighting, and insufficient dynamic adaptability, which make it difficult to align with the holistic characteristics of AI-empowered teaching scenarios [2,3]. AI technology has reshaped the entire teaching process—including classroom instruction, practical training, learning management, and school-enterprise collaboration [4]—generating massive, multi-faceted teaching big data that provide a solid foundation for quantitative assessment of talent supply quality. Constructing a digital talent supply index based on multi-source teaching big data can break through the limitations of traditional experience-based evaluations, enabling a transition from "outcome evaluation" to a comprehensive "process-plus-outcome" evaluation, and accurately portraying the capacity, quality, and adaptability of digital talent supply in higher vocational education. This paper focuses on core teaching scenarios, integrates the technical features and educational logic of AI empowerment, and builds a standardised statistical evaluation scheme, offering both theoretical and practical support for improving the quality of digital talent cultivation and for precise alignment between industry demands and educational supply.

2. Research Foundation and Core Definition

2.1 Definition of Core Concepts

AI-empowered higher vocational teaching scenarios refer to a novel instructional model that leverages digital technologies such as artificial intelligence, big data, and cloud computing to reconstruct the entire teaching process—including instructional design, implementation, practical training, learning assessment, and teacher empowerment—thereby enabling personalised instruction, intelligent management, and precision-oriented talent cultivation. This model is characterised by data-drivenness, dynamic iteration, and precise adaptability.

The supply of digital talents in higher vocational education specifically denotes the technology-skilled talents cultivated by higher vocational institutions through digital teaching systems, in response to the digital transformation needs of both the digital industry and traditional industries. Digital know-how, hands-on abilities, and creative thinking are all present in these talents. They are comfortable with digital tools. They get practical work done effectively. They also generate original solutions without much difficulty. Their supply level encompasses multiple dimensions, including resource support, the educational process, faculty competence, and output quality.

2.2 Research Theoretical Foundations

The first theoretical foundation is educational supply theory, which views vocational education as a response to the demand for skilled labour in regional industries. From this perspective, vocational institutions are expected both to prepare workers with the capabilities required by local employers and to use their existing teaching resources effectively.

The second foundation is data-driven evaluation, under which assessment is based on observable evidence rather than personal judgement. This principle is intended to improve the objectivity and comparability of the results. The third foundation is industry–education alignment theory [5–9], which focuses on the extent to which graduates' capabilities correspond to the skill requirements of digital occupations.

This question informed the selection of indicators and guided the review of the relevant literature.

Previous studies have examined, among other issues, the digital competencies of vocational teachers.

Other research has investigated how AI is applied in classroom settings and how it affects teaching and learning. Findings from these studies provided useful points of reference for adapting the indicator system to the conditions of vocational institutions.

3. Construction of the Digital Talent Supply Index Indicator System

3.1 Construction Principles

The indicator system was designed to cover the major stages of digital talent development. It therefore considers the resources available for teaching, the digital competencies demonstrated by teachers and students, the changes associated with the classroom use of AI, and graduates' subsequent workplace performance. Taken together, these dimensions provide a broad view of both the training process and its outcomes.

Objectivity was another central consideration. The indicators were selected to reflect the distinctive features of AI-enabled vocational teaching, while their weights were determined quantitatively rather than assigned through subjective judgement. This approach reduces the influence of individual preferences and strengthens the reliability of the evaluation results.

3.2 Indicator System Framework

The indicators were developed by considering the ways in which AI is used in vocational education and the meaning of digital talent supply at the institutional level. Relevant studies of digital teaching evaluation in vocational education also informed the design [10]. Table 1 presents the complete set of indicators and the corresponding data sources.

4. Statistical Evaluation Models and Data Processing

4.1 Data Sources and Preprocessing

The records were drawn from five institutional systems rather than a single database. These sources included smart teaching platforms, practical-training management systems, teacher research records, graduate employment databases, and records of skills certification and student competition performance.

The sample comprises six local public vocational colleges, with records covering the 2025 academic year. To make the indicators comparable, the raw values were normalised to a common scale ranging from 0 to 1.

4.2 Weight Calculation Method

In the entropy-weight method, an indicator with greater variation across observations has a lower entropy value and consequently receives a larger weight. The calculation proceeds in several stages. First, we arrange processed data into a standard matrix. Next, we calculate entropy value for every indicator. We convert entropy values into weight coefficients afterwards. Finally, we normalise these weights so their sum satisfies calculation requirements, and we get final weight values.

Table 1. Indicators and Data Sources for the Digital Talent Supply Index Evaluation System

First-level indicator	Secondary indicator	Indicator Definition	Data source
Digital Supply of Teaching Resources (A1)	Digital Course Coverage (B1)	The proportion of AI-powered digital courses, high-quality online courses, and digital practical training courses to the total number of courses.	Smart Teaching Platform Course Database
	Completeness of Digital Training Resources (B2)	The construction and usage of AI-powered virtual training systems, digital simulation equipment, and online training resources.	Practical Training Teaching Management System
	Digital Teaching Resource Update Rate (B3)	Proportion of Newly Added and Iterated Digital Teaching Resources Annually	Teaching Resource Management Backend Data
Teachers' Digital Teaching Competence (A2)	Teacher AI Teaching Skill Adoption Rate (B4)	The proportion of teachers who have mastered AI teaching tools and digital instructional design.	Teacher Digital Training Archive
	Volume of Digital Teaching and Research Achievements (B5)	Number of annual digital teaching projects, papers, and teaching reform achievements	Research and Teaching Management System Statistical Data
	Teacher-Student Digital Interaction Activity (B6)	Daily average activity level of teacher-student interaction, Q&A, and discussion on the AI teaching platform.	Behavioral Data from the Smart Teaching Platform
AI-Powered Teaching Effectiveness (A3)	Personalized Teaching Adaptation (B7)	Coverage effectiveness of AI-based student performance analysis, tiered instruction, and targeted tutoring.	Learning Situation Big Data Analysis Report
	Digital Control Rate of the Teaching Process (B8)	Coverage rate of digital management across the entire process—teaching preparation, instruction, and assessment.	Teaching Management Big Data Platform
	Quality of Digital Completion of Practical Training (B9)	AI virtual training and digital hands-on assessment: student pass rate and excellence rate	Internship Assessment Big Data System
Quality of Digital Talent Output (A4)	Student Digital Skills Certification Acquisition Rate (B10)	Proportion of students obtaining digital vocational skills certificates and AI skill certificates	Student Qualification Profile Database
	Digital Job Employment Rate (B11)	The employment proportion of graduates entering positions in the digital industry and digital transformation roles.	Graduate Employment Statistics Platform
	Digital Skills Competition Winning Rate (B12)	Proportion of students who have won awards in provincial-level or higher digital skills and AI application competitions	Competition Management Statistics

Human subjective judgement plays no part in this procedure. All weights come directly from variation inside original data. According to our calculation results, weights for first-level indicators are as follows: digital supply of teaching resources 0.246; digital teaching competence of faculty 0.252; effectiveness of AI-driven teaching empowerment 0.278; quality of digital talent output 0.224. The highest weight is assigned to the effectiveness of AI-driven teaching empowerment, confirming the pivotal role of AI technology in driving the supply of digital talents in higher vocational education.

4.3 Index Calculation Model

The Digital Talent Supply Index (DI) is calculated using a linear weighted composite evaluation model, with the following formula:

$$DI = \sum_{i=1}^{n} W_i X_i \tag{1}$$

Among them, W_i For the weight of the i-th secondary indicator, X_i The standardized index scores are calculated, where n represents the total number of secondary indicators. The DI value ranges from 0 to 1; the closer the value is to 1, the higher the level of digital talent supply in higher vocational education. Meanwhile, the Supply Index is divided into four levels: Excellent (0.8–1.0), Good (0.6–0.8), Qualified (0.4–0.6), and Weak (0–0.4).

5. Empirical Results and Analysis

5.1 Overall Index Calculation Results

According to model calculations, the sample institutions in 2025The average comprehensive index for annual AI-powered digital talent supply in higher vocational education is 0.712, overall...Being at a good level indicates that the overall effectiveness of AI-driven digital talent development in regional higher vocational education is significant, yet there is still room for improvement. The average scores for each first-level indicator are as follows: Digital supply of teaching resources—0.735; teachers' digital teaching competence—0.698; AI-based teaching...The empowerment effectiveness of AI-driven teaching is 0.742, and the quality of digital talent output is 0.679. It can be seen that AI-driven teaching empowerment and the effectiveness of digital teaching resource development are particularly prominent, while teachers' digital literacy and the quality of talent output have become the main bottlenecks hindering the upgrading of talent supply.

5.2 Dimensional Shortfall Analysis

First, the shortcomings in teachers' digital teaching competence have become particularly evident. Three major bottlenecks stand out in the current talent development process. Let us begin with the third one. Some institutions do not use AI to its full potential in teaching. As a result, their digital instruction becomes superficial. Training scenarios lack variety. Personalized and targeted education is only offered to a limited extent. This is clearly not enough. Next, look at teacher capabilities. Many instructors are not skilled enough with AI-based classroom tools. Their research and development work stays weak on the digital front.

6. Optimization Measures

6.1 Strengthening Teachers Digital Literacy Empowerment

Schools can hold regular workshops covering AI-tool operation for classrooms, digital lesson design and student performance analysis supported by big data. All teaching staff can take part in these learning activities.

Schools may build joint digital research platforms with cooperating enterprises. They can make use of enterprise digital-technology resources and encourage teachers to join real industrial digital-transformation projects. These practical experiences help teachers improve their digital-teaching innovation capacity and practical-skill guidance ability for students.

6.2 Deepen the In-Depth Application of AI in Teaching Scenarios

Break through the bottlenecks in the formalized application of AI in education by leveraging big data on student learning conditions to build a personalized, tiered, and precision-oriented AI teaching model that enables tailored instruction for each student. Enrich AI-powered virtual training and digital simulation teaching scenarios, continuously updating training content to align with the digitalization demands of industry positions, and strengthen students' hands-on digital skills training. Perfect the digital control system covering the entire teaching process, achieving dynamic closed-loop management of teaching activities, practical training assessments, and student learning condition monitoring.

6.3 Promote Precise Alignment and Integration of Industry and Education through Digital Transformation

Leveraging multi-source big data, we are building a platform for matching industry and education supply and demand, accurately analyzing the dynamic changes in regional digital industry talent needs, and dynamically adjusting specialty curricula and talent development programs. We are deepening collaborative education between universities and enterprises, jointly establishing AI training bases and digital skills courses with digital companies, ensuring seamless alignment between teaching content and job market requirements, and enhancing graduates' adaptability to digital roles as well as the quality of their employment.

6.4 Establish an Index-Based Dynamic Monitoring Mechanism

Integrate the Digital Talent Supply Index into the core framework for evaluating the quality of higher vocational education, and establish a dynamic evaluation mechanism featuring monthly monitoring, quarterly analysis, and annual review. The ultimate goal is to find weak spots in talent development. Big-data platforms collect indicator data automatically and finish index calculation once new data arrive. They send risk warnings before small problems expand. Most monitoring work can run without heavy manual work. Schools can locate exact training weaknesses through system outputs. Evaluation, analysis, correction and optimisation form a circulating closed-loop workflow.

7. Conclusion and Outlook

Many vocational teachers still have gaps in digital competence, and their practical ability to use AI within classroom practice remains limited. Graduate competence cannot always satisfy employer expectations, and AI technology is only used at shallow levels inside many classrooms. These practical problems expose defects of traditional talent-evaluation approaches, which are subjective, fragmented and slow to respond to changes. For these reasons, we designed a new assessment system for digital talent supply.

From our empirical outcomes, regional higher vocational colleges achieve generally good performance on AI-driven digital talent supply. Even so, the weak points we summarised above still restrict further improvement. Our indicator system solves typical defects of traditional evaluation such as subjectivity, fragmentation and time lag. It produces objective measurable values for colleges' digital talent-supply level, helping institutional administrators understand their own real conditions.

For follow-up research work, we plan to expand indicator dimensions.

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